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NOMENCLATURAL NOTES ON PHILIPPINE PLANTS

By ELMER D. MERRILL

Of the University of California, Berkeley

Through the courtesy of Dr. Edwin Bayer, of the National Museum, Prague, I recently had the opportunity of examining several hundred unnamed Philippine specimens collected by Haenke under the auspices of the Malaspina Expedition. At the same time a number of Presl's types were loaned to me, from an examination of which it has been possible definitely to place several of his proposed species that were previously, because of incomplete descriptions, considered as of doubtful status. In species more recently described it has become necessary to propose new specific names, because those originally published by me were preoccupied. As the type of the genus *Plectronia* has been shown to be identical with *Olinia*, this generic name is abandoned in the Rubiaceæ and the Philippine species there placed are transferred to *Canthium*.

GRAMINEÆ

Genus ARISTIDA Linnæus

ARISTIDA SORZOGONENSIS Presl.

Aristida sorzogonensis PRESL, Rel. Haenk. 1 (1830) 224.

In my Enumeration of Philippine Flowering Plants [1] I placed this under the excluded species, with the comment that the record (Sorsogon) was probably based on an erroneously labeled specimen, the species in all probability being American. An examination of Presl's type in the Prague Herbarium shows

[1] Bur. Sci. Publ. No. 18 1 (1922) 80.

that the species is a true *Aristida,* but is remote from all of the few known Philippine species. Prof. H. G. Hitchcock states that it is not any of the species of the United States, and does not match any of the species of Ecuador, Peru, and Bolivia known to him. I still believe that the actual type was from either South America, the west coast of North America, or possibly Australia, although it is possible that a Philippine species is represented that has not appeared in the extensive Philippine collections made since Haenke's time. Professor Hitchcock further states that at first he took the species to represent *Aristida setifolia* HBK. of tropical America, but that the callus does not agree with that of the latter species.

Genus SETARIA Beauvois

SETARIA GLOBULARIS Presl.

Setaria globularis PRESL, Rel. Haenk. 1 (1830) 314; SCRIBNER in Rept. Missouri Bot. Gard. 10 (1899) 52.

This was based on a Haenke specimen, "Hab. in insulis Philippinis," but is manifestly not a Philippine plant and was excluded by me. Scribner states that the sheet in the Bernhardi Herbarium at the Missouri Botanical Garden represents three species; one *Setaria caudata* Lam., as interpreted by him, one S. *composita* Kunth, the third not determinable. The specimen in the Prague Herbarium represents a single species. Regarding the fragment forwarded to him for examination Professor Hitchcock states that it matches two specimens collected by Mrs. Chase in Brazil that had tentatively been placed under *Setaria rariflora* Presl and which may represent *Setaria caudata* of Brazilian authors, but not *Setaria caudata* Lam. of the West Indies. Haenke's specimen and the two specimens collected by Mrs. Chase differ from the species mentioned above in having prominently rugose fruit. Professor Hitchcock states that he does not see how Presl could have secured Brazilian material. The species is safely not Philippine.

Genus PASPALUM Linnæus

PASPALUM BORYANUM Presl.

Paspalum boryanum PRESL, Rel. Haenk. 1 (1828) 209; MERR., Enum. Philip. Fl. Pl. 1 (1922) 57.

In the Enumeration of Philippine Flowering Plants this is placed under the excluded species, with the comment that it may prove to be a *Digitaria,* or some American species of *Paspalum,* although Presl's type was localized as from Sorsogon, Luzon. I have recently had the opportunity of examining Presl's type

in the Prague Herbarium, and it is identical with the Philippine form I have referred to *Paspalum vaginatum* Sw., but which Hackel referred to *Paspalum distichum* Linn.; see Kneucker *Gram. exsic. 805* from Rizal Province, Luzon, which is identical with *Paspalum boryanum* Presl. Professor Hitchcock confirms this identification as *Paspalum distichum* Sw.

Genus SPOROBOLUS R. Brown

SPOROBOLUS SCOPARIUS Presl.

Sporobolus scorparius PRESL, Rel. Haenk. 1 (1830) 243.

On the assumption that the species described by Presl was a *Sporobolus*, type from Sorsogon, Luzon, I stated:[2] "Certainly not a Philippine species, but probably based on American material." An examination of Presl's type in the Prague Herbarium clearly shows that *Sporobolus scoparius* Presl is identical with the common and widely distributed *Thysanolaena maxima* (Roxb.) O. Kuntze = *Thysanolaena procera* (Retz.) Mez in Bot. Archiv 1 (1922) 27; *Agrostis procera* Retz., Obs. 4 (1779) 19. The name *Thysanolaena procera* (Retz.) Mez is the oldest valid one for this species. The panicles are commonly used in making brooms in the Philippines, whence Presl's specific name.

Genus BROMUS Linnæus

BROMUS LUZONENSIS Presl.

Bromus luzonensis PRESL, Rel. Haenk. 1 (1828) 262 "Hab. in Luzonia," Presl.

Of this I have seen a single detached spikelet, without its pedicel. I still believe that the material could not possibly have originated in the Philippines. Regarding the fragment, Professor Hitchcock states that he has not been able to determine it satisfactorily, although the spikelet compares very well with *Bromus lanatus* HBK., a species of tropical America; Presl's description does not agree, as he describes it as having short stiff pedicels, while *Bromus lanatus* HBK. has rather slender curved ones. It is indeed difficult to determine why Kunth referred this species to *Triticum;* it is a true *Bromus*.

Genus DIGITARIA Scopoli

PASPALUM MOLLE Presl, Rel. Haenk. 1 (1828) 213 "Hab. in Luzonia," Presl.

The specimen in the Prague Herbarium is a *Digitaria*. Regarding it Professor Hitchcock states that it matches three specimens in the United States National Herbarium; namely,

[2] An Enumeration of Philippine Flowering Plants 1 (1922) 81.

Ramos 1125, from British North Borneo, and two specimens collected by himself, one near Canton, China, the other at Dong Hoi, Annam. These were placed under *Digitaria longiflora* (Gmel.) Pers., but marked *plant villous*. Professor Hitchcock states that it may represent a distinct species. In view of the fact that Presl's type matches oriental material, the locality cited is undoubtedly correct. *Paspalum mollicomum* Kunth and *Syntherisma molle* Scribner are synonyms.

PASPALUM FUSCUM Presl, Rel. Haenk. 1 (1828) 214 "Hab. in Luzonia ? in Peruviae montanis huanoccensibus ? Mexico ?"

There are two specimens on the sheet in the Prague Herbarium, one with two spikes, the other with ten spikes; Scribner's figure of the cotype in the Berhardi Herbarium represents a specimen with four or five spikes.[3] Professor Hitchcock thinks that the small specimen with two spikes is *Digitaria longiflora* (Gmel.) Pers., and that the larger specimen with ten spikes, which is manifestly the type, as Presl's description states that the spikes are eight to thirteen, is *Digitaria chinensis*. The statement "culmo repente" probably refers to *Digitaria longiflora* (Gmel.) Pers. Presl's name, being the earlier, is here adopted.

DIGITARIA FUSCA (Presl) comb. nov.

Paspalum fuscum PRESL, Rel. Haenk. 1 (1828) 214; KUNTH, Enum. 1 (1833) 46.

Paspalum filiculme Nees ex THWAITES, Enum. Pl. Zeyl. (1864) 358.

Digitaria violascens MERR., Fl. Manila (1912) 88, non Link.

Syntherisma fusca SCRIBNER, Rept. Missouri Bot. Gard. 10 (1899) 49, *t. 11*.

Paspalus chinense Nees in HOOK. and ARN., Bot. Beechey's Voy. (1841) 231.

Digitaria chinensis MERR., Enum. Philip. Fl. Pl. 1 (1922) 53, here by error credited to Nees.

By many authors this is considered as synonymous with *Digitaria longiflora* (Gmel.) Pers.

CYPERACEÆ

Genus CYPERUS Linnæus

CYPERUS LUZONENSIS Presl.

Cyperus luzonensis PRESL, Rel. Haenk. 1 (1828) 174.

Because of the characters given by Presl in the original description, type from Luzon, and as I was unable to place the species from the description alone, I considered this under the

[3] Rept. Missouri Bot. Gard. 10 (1899) *t. 11*.

doubtful and excluded species of *Pycreus*. An examination of the type in the Prague Herbarium shows *Cyperus luzonensis* Presl to be identical with the common and widely distributed *Cyperus pilosus* Vahl.

CYPERUS MINUTIFLORUS Presl.

Cyperus minutiflorus PRESL, Rel. Haenk. 1 (1830) 251; MERR., Enum. Philip. Fl. Pl. 1 (1922) 109, cum syn.

This was placed by me under the doubtful and excluded species because of the inadequate description. An examination of a fragment of the type from the Prague Herbarium indicates that it is a juvenile form of the common and widely distributed *Cyperus haspan* Linn. *Cyperus minutiflorus* Presl and its synonyms *C. micranthus* Presl non Nees, *C. breviflorus* Dietr., and *C. multiflorus* Kunth thus become synonyms of the Linnean species.

CYPERUS PHILIPPENSIS Presl.

Cyperus philippensis PRESL, Rel. Haenk. 1 (1828) 174.

This species was placed by me under the doubtful and excluded species, the type being from Luzon. An examination of a small fragment of the type, an immature specimen, seems to indicate that a form of *Torulinium ferax* (L. C. Rich.) Ham. is represented, and I make this tentative reduction of Presl's species.

CYPERUS ALBUS Presl.

Cyperus albus PRESL, Rel. Haenk. 1 (1828) 175.

This was placed by me under the doubtful and excluded species of *Pycreus*, because of Presl's description stating that it has two style arms. The type was from Luzon. I have seen only a very small fragment of Haenke's specimen, and most of the styles are two-armed; it does not appear, however, to be a *Pycreus*, but is suggestive of *Cyperus stoloniferus* Retz., which it probably represents. An unnamed specimen from Mexico, *Palmer 377*, also rather closely resembles Haenke's specimen, as far as comparisons are possible with merely very fragmentary material of the latter.

Genus FIMBRISTYLIS Vahl

FIMBRISTYLIS PILOSA Vahl.

Fimbristylis pilosa Vahl, PRESL, Rel. Haenk. 1 (1828) 191.

The identification of Haenke's Sorsogon plant as representing Vahl's species is probably correct. In placing the record of this as Philippine under the doubtful and excluded species I stated that the specimen probably represents a form of *Fimbristylis*

annua R. and S. An examination of Haenke's specimen shows this to be the correct disposition of this Philippine record.

FAGACEÆ

Genus QUERCUS Tournefort

QUERCUS BUDDII nom. nov.

Quercus robinsonii MERR. in Philip. Journ. Sci. 10 (1915) Bot. 297, non Ridl. (1914).

Synaedrys robinsonii KOIDZ. in Bot. Mag. Tokyo 30 (1916) 192.

Lithocarpus robinsonii REHD. in Journ. Arnold Arb. 1 (1919) 130.

My original specific name for the species of central Luzon is invalidated by *Quercus robinsonii* Ridl., a species of the Malay Peninsula described one year earlier. The new name proposed here is derived from Dr. C. B. Robinson's middle name.

TILIACEÆ

Genus BROWNLOWIA Roxburgh

BROWNLOWIA ARGENTATA Kurz.

Brownlowia argentata KURZ in Journ. As. Soc. Bengal 39^{2} (1870) 67; SCHEFF. in Nat. Tijd. Ned. Ind. 34 (1874) 94.

Brownlowia riedelii HEMSL., Bot. Challenger Exped. 1^{3} (1885) 128; MERR., Enum. Philip. Fl. Pl. 3 (1923) 22; RIDL., Fl. Malay Penin. 1 (1922) 292.

Brownlowia lepidota WARB. in Bot. Jahrb. 18 (1893) 200.

Malay Peninsula, Borneo, Mindanao, Moluccas, Wetter, New Guinea, along tidal streams and on or near the seashore.

Kurz's type was from Buru Okie (Boeroe-oki) in the Moluccas, a specimen collected by Teysmann. The native name cited by him, *atún laut* (*laut*, ocean), clearly indicates that Teysmann's specimen was a strand plant. The description in all respects applies to the form later described by Hemsley as *Brownlowia riedelii*, type from Wetter, near the west end of Timor, southeastern Moluccas, and still later by Warburg as *Brownlowia lepidota*, type from Finschhafen, New Guinea.

MELASTOMATACEÆ

Genus MEMECYLON Linnæus

MEMECYLON LITTORALE nom. nov.

Memecylon revolutum MERR. in Philip. Journ. Sci. 8 (1913) Bot. 226; Enum. Philip. Fl. Pl. 3 (1923) 216, non Thwaites.

This new name for the species of northern Luzon is needed, as the one I originally used is preoccupied for the Ceylon species described by Thwaites.

SYMPLOCACEÆ

Genus SYMPLOCOS Jacquin

SYMPLOCOS ILOCANA nom. nov.

Symplocos brachybotrys MERR. in Philip. Journ. Sci. 14 (1919) 447, non Merr. in Journ. Straits Branch Roy. As. Soc. 76 (1917) 110.

Luzon, Ilocos Norte Province, *Bur. Sci. 33277 Ramos.*

A new name is needed for this Philippine species, as in publishing it I overlooked the fact that I had already used the same name for an entirely different Bornean species.

RUBIACEÆ

Genus CANTHIUM Lamarck

(*Plectronia* auctt., non Linn.)

It becomes necessary to adopt Lamarck's generic name for the group which many modern botanists have designated as *Plectronia.* The Linnean genus was based on a single species, *Plectronia ventosa* Linn.,[4] the generic description being based on an actual specimen, except for the fruit and seed characters, which were taken from Burman. The specimen is an *Olinia,* and this single genus forms the family Oliniaceæ. Linnæus was in error in adding the fruit and seed characters from Burman and in adding to the species description the reference to "*Burm. afr. 257, t. 94.*" which is *Plectronia* (*Canthium*) as currently interpreted. Apparently most botanists who have accepted *Plectronia* as the proper name of this rubiaceous genus interpreted it from the reference to Burman and did not critically scan the generic description which is unmistakably of *Olinia. Olinia* Thunberg (1799), unless it be protected by ultimate inclusion in some future list of *nomina conservanda,* will be replaced by *Plectronia* Linnæus (1767), and the family Oliniaceæ would have to be renamed.

The Philippine species described under *Plectronia* are here transferred to *Canthium:*

CANTHIUM BRUNNEUM (Merr.) comb. nov.

Plectronia brunnea MERR. in Philip. Journ. Sci. 17 (1920) 535; Enum. Philip. Fl. Pl. 3 (1923) 535.

CANTHIUM CORDATUM (Merr.) comb. nov.

Plectronia cordata MERR. in Philip. Journ. Sci. 12 (1917) Bot. 166; Enum. Philip. Fl. Pl. 3 (1923) 535.

[4] Linnæus, C., Mantissa Plantarum 1 (1767) 6, 52.

CANTHIUM CULIONENSE (Elm.) comb. nov.

Lasianthus culionensis ELM., Leafl. Philip. Bot. 1 (1906) 11.
Plectronia culionensis MERR., Enum. Philip. Fl. Pl. 3 (1923) 535.

CANTHIUM DICOCCUM (Gaertn.) comb. nov.

Psydrax diococcos GAERTN., Fruct. 1 (1788) 125, *t. 26*.
Canthium didymum GAERTN. f., Fruct. 3 (1805) 94.
Plectronia didyma ELM., Leafl. Philip. Bot. 1 (1906) 28.

CANTHIUM ELLIPTICUM (Merr.) comb. nov.

Plectronia elliptica MERR. in Philip. Journ. Sci. 12 (1917) Bot. 165; Enum. Philip. Fl. Pl. 3 (1923) 536.

CANTHIUM ELMERI nom. nov.

Plectronia gracilipes ELM., Leafl. Philip. Bot. 3 (1911) 1008; MERR., Enum. Philip. Fl. Pl. 3 (1923) 536, non *Plectronia gracilipes* Kurz (1877), nec *Canthium gracilipes* Kurz (1872).

CANTHIUM FENICIS (Merr.) comb. nov.

Plectronia fenicis MERR. in Philip. Journ. Sci. 8 (1913) Bot. 50; Enum. Philip. Fl. Pl. 3 (1923) 536.

CANTHIUM GLANDULOSUM (Blanco) comb. nov.

Ixora glandulosa BLANCO, Fl. Filip. (1837) 61.
Plectronia glandulosa MERR., Sp. Blancoanae (1918) 365; Enum. Philip. Fl. Pl. 3 (1923) 536, cum syn.

CANTHIUM LEYTENSE (Merr.) comb. nov.

Plectronia leytensis MERR. in Philip. Journ. Sci. 8 (1913) Bot. 49; Enum. Philip. Fl. Pl. 3 (1923) 537.

CANTHIUM MABESAE (Elm.) comb. nov.

Plectronia mabesae ELM., Leafl. Philip. Bot. 8 (1919) 3099; MERR., Enum. Philip. Fl. Pl. 3 (1923) 537.

CANTHIUM MEGACARPUM (Merr.) comb. nov.

Plectronia megacarpa MERR. in Philip. Journ. Sci. 4 (1909) Bot. 326; Enum. Philip. Fl. Pl. 3 (1923) 537.

CANTHIUM MONSTROSUM (A. Rich.) comb. nov.

Plectronia monstrosa A. RICH., Mém. Rub. (1830) 109; MERR., Enum. Philip. Fl. Pl. 3 (1923) 538, cum syn.

CANTHIUM OBOVATIFOLIUM (Merr.) comb. nov.

Plectronia obovatifolia MERR. in Philip. Journ. Sci. 12 (1917) Bot. 167.

CANTHIUM OLIGOPHLEBIUM (Merr.) comb. nov.

Plectronia oligophlebia MERR. in Philip. Journ. Sci. 17 (1920) 442; Enum. Philip. Fl. Pl. 3 (1923) 538.

CANTHIUM PAUCINERVIUM (Merr.) comb. nov.

Plectronia paucinervia MERR. in Philip. Journ. Sci. 8 (1913) Bot. 51; Enum. Philip. Fl. Pl. 3 (1923) 538.

CANTHIUM RAMOSII (Merr.) comb. nov.

Plectronia ramosii MERR. in Philip. Journ. Sci. 17 (1920) 443; Enum. Philip. Fl. Pl. 3 (1923) 539.

CANTHIUM SARCOCARPUM (Merr.) comb. nov.

Plectronia sarcocarpa MERR. in Philip. Journ. Sci. 10 (1915) Bot. 114.

CANTHIUM SUBCAPITATUM (Merr.) comb. nov.

Plectronia subcapitata MERR. in Philip. Journ. Sci. 17 (1920) 443; Enum. Philip. Fl. Pl. 3 (1923) 539.

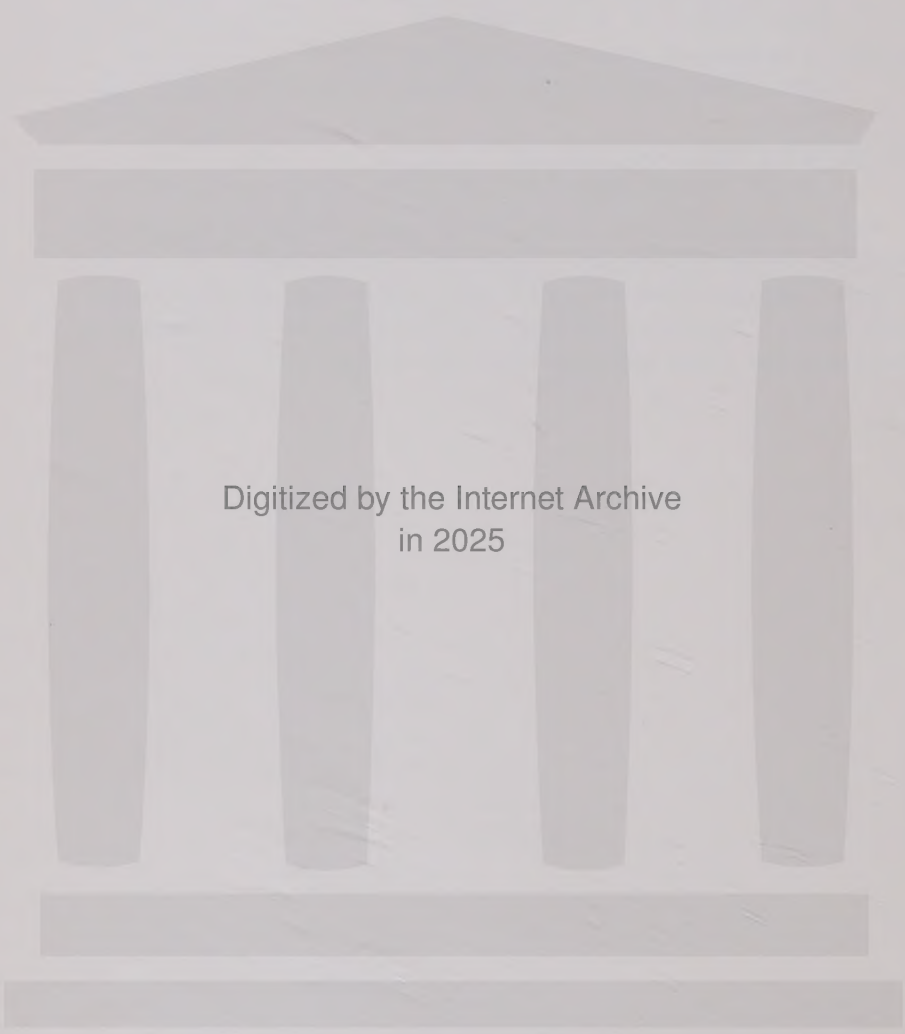
CANTHIUM SUBSESSILIFOLIUM (Merr.) comb. nov.

Plectronia subsessilifolia MERR. in Philip. Journ. Sci. 12 (1917) Bot. 168.

CANTHIUM WENZELII (Merr.) comb. nov.

Plectronia wenzelii MERR. in Philip. Journ. Sci. 9 (1914) Bot. 387.

The remaining species have already been considered by various authors under *Canthium*. *Plectronia gynochthodes* Merr. becomes *Canthium gynochthodes* Baill., *Plectronia horrida* Benth. and Hook. f. becomes *Canthium horridum* Blume, and *Plectronia pedunculatis* Vidal becomes *Canthium pedunculare* Cav.



TRICHURIASIS: RELATION BETWEEN THE NUMBER OF OVA PER GRAM OF FORMED STOOL AND THE NUMBER OF FEMALE WORMS HARBORED BY THE HOST

By C. MANALANG

Of the Philippine Health Service, Manila

This article deals with careful observations on a few clinical and autopsy cases previously studied for the purpose of determining the correlation between the number of hookworm ova per gram of formed stool and the number of female worms discharged by treatment or found at autopsy.

The egg-counting method and autopsy procedure are described in the two preceding articles in this series, on Ancylostomiasis. [1]

The only point worthy of note is the fact that, due to the embedding of the thinner portion of the *Trichuris* in the mucosa, care was taken to remove all the worms from the cæcum even at the risk of leaving their slender portions. No adult parasites were ever found in the appendix, the ileum, or the transverse colon. The portion of stool removed in the morgue by puncture of the cæcum to make possible the counting of the eggs was examined well for adults, and a good many were thus found. The chance of losing *Trichuris* was much less than in the case of hookworms, because of their size and habitat.

The sex of the worms is easily distinguished by the naked eye, as the male has a spiral thick portion. Only one or two young worms were encountered. They were readily recognized due to the fact that they are small and white, while the adults resemble old ivory in color.

Table 1 shows four clinical cases of trichuriasis, with pretreatment counts, number and sex of the worms removed, and posttreatment counts. The treatment was by means of chenopodium oil the method of administration of which has already been described. As in the previous studies, the egg counts per gram of stool were all reduced to "formed basis," using Stoll's

[1] Philip. Journ. Sci. 33 (1927) 35–65.

factor of 1, 2, and 4 for formed, mushy, and diarrhœal stools, respectively. No factor for the number of ova per gram per female was used, it being one of the objects of this study to determine such, if possible.

Since chenopodium does not expel *Trichuris* with certainty, the number of female worms recovered in the forty-eight-hour-treatment stools could not be said even to represent any known percentage of the total worms harbored; this could be determined better in the post-mortem cases. Experience has also taught that some worms might have been expelled after the forty-eight hours or not expelled at all. The only object in presenting Table 1 is to show the variability of the egg counts. Control counts were made four to five days after treatment. In case the patient failed to pass a stool in the second twenty-four hours, stools for the third twenty-four hours were saved.

CLINICAL CASES

Table 1 shows the protocols of four clinical cases.

Case 1, with 200 ova per gram before treatment, showed 2,025 per gram after treatment. Either worms were not expelled at all, or were expelled after forty-eight hours, but the discrepancy is apparent and cannot well be attributed to errors in counting.

Case 2 showed 2,100 ova per gram before treatment, and none after treatment. Here again the worms might have been passed after forty-eight hours.

Case 3 had 1,400 ova per gram, and treatment removed 7 males and 6 females. The control count showed 900 ova per gram, apparently only a slight diminution in the post-treatment egg count when some worms might have been passed after forty-eight hours.

Case 4 was almost the reverse of case 3, showing diminution from 900 ova per gram before treatment to 150 after treatment, which removed only one unclassified worm. Again, some might have been passed after forty-eight hours.

POST-MORTEM CASES

Tables 2 to 14 present the data from eighteen cadavers, showing sigmoidal or rectal counts in the first six cases (Table 2) and regional (ileal, cæcal, transversal, and sigmoidal or rectal) in the rest of the cases. In view of the nature of the causes of death of cases 8, 11, 17, and 18, they were classified as

normal controls. Due to absence of intestinal pathology in cases 2, 6, 7, 9, and 14, they could also be considered normal controls. Cases, 1, 3, 4, 5, 10, 12, 13, 15, and 16 all had intestinal pathology which might have influenced the females and their egg output or have produced mechanical hindrance or rapid deposition of the stools of the host during life. For the purpose of clearness the above classifications are designated as groups 1, 2, and 3, in which groups 1 and 2 are control cases and group 3 contains cases with intestinal pathology.

Considering control cases 7, 8, 9, 11, 14, 17, and 18 (cases of groups 1 and 2 counted regionally only) there were 31,625 ova in the cæcum, 12,750 ova in the transverse, and 10,275 ova in the sigmoid or rectum per gram of stool reduced to "formed basis." The total number of female worms recovered from these cases was 59; therefore, each female was represented by 536 ova per gram of stool in the cæcum, 216 ova in the transverse, and 174 in the sigmoid or rectum, with an average of 308 ova per gram of stool, "formed basis," for the three regions in the control cases and the cases without intestinal pathology.

When all the egg counts in the nine control cases (2, 6, 7, 8, 9, 11, 14, 17, and 18) without intestinal pathology (both regionally and sigmoidally counted cases) were added, there was a total of 58,550 ova from twenty-three regions. The number of females recovered from the cases counted regionally was multiplied by 3 while those counted sigmoidally were taken as counted. The total for the twenty-three regions was 188 female worms, or 311 ova per gram of stool per female, in the nine cases computed regionally and sigmoidally. The *Trichuris* egg factor per gram of stool, "formed basis," per female, may therefore be placed at around 310 in this series.

Cases with intestinal pathology, counted regionally (cases 10, 12, 13, 15, and 16), gave a total of 11,750 ova in the cæcum, 5,400 ova in the transverse, and 4,950 ova in the sigmoid or rectum, deposited by a total of 11 female worms, or 1,068 ova per gram per female in the cæcum, 491 in the transverse colon, and 450 in the sigmoid or rectum, with an average of 669 ova for all three regions.

It is evident that in the cases counted regionally, regardless of the condition of the alimentary tract, the number of *Trichuris* ova per gram of cæcal stool is higher than the number in either the transverse colon or the sigmoid. This is probably due to the parasitic concentration and fæcal stasis in the cæcum.

It is also apparent that the number of ova per gram of stool per female in the cases with intestinal pathology was about twice the number obtained in cases without intestinal pathology.

Examination of the tables will show marked variation between the number of ova per gram per female worm, considering the number of females found, and the number of ova per gram per female found when considered regionally; namely, from 50 ova per gram of stool per female in case 7 to 2,250 ova per gram of stool per female in case 14, both without intestinal pathology, and from 61 ova per gram of stool per female in case 3 to 8,392 ova per gram of stool per female in case 1, two cases with intestinal pathology. These figures were obtained by taking the average count for three regions surveyed (cæcum, transverse, and sigmoid) in each case dividing by the number of female worms recovered from the case.

Regionally, case 8, a rapid death by suicide, gave 679 ova per gram of stool per female in the cæcum, 121 ova in the transverse, and 208 ova per gram per female in the sigmoid.

Case 1 gave the high sigmoidal count of 8,392 ova per gram per female. A fæcal fistula was established about a week before death. This may be explained by the fact that the fistula drained well and, since no intestinal contents passed the obstruction and no normal stools passed per rectum during the time, the colon stool remained unmoved while the worms continued to lay eggs; unfortunately, regional counts were not made in this case. Proctoclysis was given. The females may have been good egg layers, or the fæcal stasis favored egg deposition.

Case 3, however, with fæcal fistula for two weeks and no normal stool per rectum since the date of operation (one month before death), did not show evidence of egg accumulation (61 ova per gram per female), which may have been prevented by the frequent enemas given. Even if a fæcal fistula had been present, there was no obstruction in the colon; so that very likely there was less stagnation in the colon. This may have been a case of poor egg-laying females or of unfavorable environment for egg laying.

Case 7 showed a rather low egg count (50 ova per gram per female, average for three regions counted), in the absence of intestinal pathology.

Two cases of typhoid fever (cases 4 and 12) with intestinal hæmorrhage gave similar egg counts (150) per gram of stool

per female; but case 10, also of typhoid fever with hæmorrhage, gave 1,875 ova for the sigmoid, 1,575 ova for the transverse, and 3,825 ova for the cæcum per gram of stool per female. This was another case of good egg-laying females. The presence of ova in the ileal content is explained by the large ulcerations on the ileocæcal valve, which permitted regurgitation of the cæcal content.

Case 14, with death from pneumococcic meningitis, showed 750 ova for the sigmoid, 1,050 ova for the transverse, and 4,950 ova for the cæcum per gram of stool from a single female recovered; this is another case of high egg production.

Case 16 (death following ptomain poisoning, with diarrhœa and vomiting, symptoms which were stopped by the administration of heavy doses of opiates forty-eight hours before death), clearly showed fewer ova—1,700 per gram in the cæcum, 300 ova per gram in the transverse, and none in the rectum. The decrease was probably due to diarrhœa.

Relatively high cæcal counts were evident in cases 8, 10, 11, 12, 13, 14, 16, 17, and 18 (75 per cent of all the cases counted regionally). In these nine cases were included all of group 1, normal controls (cases 8, 11, 17, and 18), one case without intestinal pathology (group 2, case 14), two cases of typhoid fever (cases 10 and 12), the case of amœbiasis (case 13), and the case of ptomain poisoning (case 16).

This high cæcal count could not have been due to volumetric variation in the stool, as the cæcum usually contained a considerable amount of stool. It was probably due to parasitic concentration, stasis, or a biological reaction of the female to the environment.

Relatively lower cæcal counts were observed in case 7 (pulmonary tuberculosis with hæmorrhage), case 9 (with beriberi), and case 15 (a violently insane American the autopsy findings on whom were meningeal and subdural hæmorrhage with about 2 kilograms of dry impacted stools in the colon).

In the light of the factor (310 ova per gram of stool per female *Trichuris*) obtained in groups 1 and 2 (cases of sudden death and deaths without intestinal pathology), the variations in the folowing cases are evident.

Case 1 (with the very high count of 8,392 ova per female found) and case 12 (with the relatively low count of 150 ova per female if only one was present, though not recovered) were

due to fæcal stasis in the former, and to intestinal hæmorrhage in the latter, both mechanical factors. Case 3 (with repeated enemas) gave the low sigmoid count of 61 ova per gram per female.

Biological factors seem to have produced high counts in cases 10, 13, and 14; to these may be added case 1. Low count was evident in case 7. In spite of hæmorrhage from typhoid fever ulcers, case 10 gave 3,825, 1,575, and 1,875 ova per gram of stool per female in the cæcum, transverse, and sigmoid, respectively; the regurgitation of ova into the ileum has already been mentioned. The count for case 13 was apparently moderately high in the presence of amœbic ulcerations, while case 14, in the absence of intestinal pathology, with 4,950, 1,050, and 750 ova per gram of stool per female in the cæcum, transverse, and sigmoid, respectively, can be explained only by a high rate of egg production of the single female worm found.

In view of the highly resistant nature of the shell of the ova it is likely that ovolysis would not take place, though it is very peculiar that ova were not seen in the rectal stool of case 15, although ova were present in the cæcum and transverse. This case also failed to show hookworm ova in the rectal stool by the counting method, in spite of the 470 female worms found.

SUMMARY

1. *Trichuris* egg counts were made carefully on four clinical cases and eighteen fresh cadavers, previously studied under ancylostomiasis.

2. The clinical cases showed unreasonable variations between the pretreatment and the posttreatment counts.

3. Rectal or sigmoidal counts were made in six of the eighteen cadavers, and regional (ileum, cæcum, transverse, and rectum or sigmoid) in twelve.

4. The cases were classified into normal controls, or cases who died of violence, suddenly, or of some disease without intestinal pathology (nine cases), and pathological controls, or cases with intestinal pathology, either organic or functional (nine cases).

5. The *Trichuris* egg factor was found to be around 310 ova per gram of "random" stool, "formed basis," per female worm, for nine control cases, computed from twenty-three regions.

6. The average number of ova per gram of stool per female found for the cæcum, transverse, and sigmoid in cases with intestinal pathology was about twice that found in cases without intestinal pathology—669 in the former, and 310 in the latter.

7. Regardless of the condition of the alimentary tract, the number of ova per gram of stool in the cæcum per female worm was about equal to that in the transversal and sigmoidal stools combined.

8. Relatively high cæcal counts were evident in 75 per cent of all cases surveyed regionally. This was due probably to parasitic concentration, to fæcal stasis, or to biological reaction of the female to the environment. Based on the number of females found, marked variations in egg counts were observed between similar cases and between intestinal regions of the same case in both the normal and the pathological controls.

9. In one case of typhoid fever, *Trichuris* ova were found in the ileum owing to regurgitation of cæcal contents through a badly ulcerated ileocæcal valve.

10. In view of the highly resistant nature of the eggshell it is likely that ovolysis was not responsible for the low counts observed, though one case (15) seems to suggest this possibility.

11. The variations observed in the egg counts appeared to be influenced by mechanical and biological factors.

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TABLE 1.—*Pretreatment and posttreatment egg counts in four cases of trichuriasis.*

Serial No. of patient.	Name.	Pretreatment egg count.			Parasites recovered.			Posttreatment egg count.		
		Type of stool.	Number of ova per gram.	Number of ova reduced to "formed basis."	Male.	Female.	Total.	Type of stool.	Number of ova per gram.	Number of ova reduced to "formed basis."
1	V.J	Mushy	100	200	0	0	0	Formed	2,025	2,025
2	M.R	do	1,050	2,100	0	0	0	Mushy	0	0
3	G.C	Diarrhœal	375	1,400	7	6	13	Formed	900	900
4	T.V	do	225	900	(a)	(a)	9	do	150	150

[a] Not classified.

TABLE 2.—*Showing sigmoidal or rectal egg counts in cases 1 to 6, inclusive.*

Serial No. of patient.	Name.	Type of stool.	Number of ova per gram in sigmoid or rectum.	Number of ova reduced to "formed basis."	Adult worms found.		Number of ova per female.	Remarks.
					Male.	Female.		
1	M.A	Formed	201,400	201,400	14	24	8,392	Autopsy findings, intestinal obstruction. Fæcal fistula established one week before death. No stools per rectum.
2	B.L	do	150	150	0	1	150	Broncho-pneumonia.
3	C.F	do	675	675	5	11	61	Antemortem and post-mortem findings, lymphosarcoma of the jejunum and mesentery. Fistula spontaneously established at point of enterostomy. No intestinal obstruction.
4	W.G	Mushy	225	450	1	3	150	Typhoid fever with hæmorrhage two days before death; stool black and mushy.
5	G.F	do	300	600	3	3	200	Catarrhal enterocolitis.
6	H.A	do	1,875	3,750	7	10	375	Autopsy findings, punctate hæmorrhage in the brain, possibly due to ascariasis. Age of patient, 13 months; admitted suffering from convulsions.

TABLE 3.—*Showing egg counts in case 7, R.D.*[a]

	Stool from—			Remarks.
	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	[b]	[b]	[b]	Autopsy findings, acute anæmia and asphyxia due to massive pulmonary hæmorrhage in chronic ulcerative and miliary tuberculosis of both lungs.
Ova per gram	0	75	75	
Ova, reduced to "formed basis"	0	150	150	
Ova per female, by region	0	75	75	

[a] Total parasites found, 2 males and 2 females. [b] Mushy.

TABLE 4.—*Showing egg counts in case 8, B.F.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	[b]	[c]	[c]	[c]	Acute anæmia and hæmothorax with atelectasis of the left lung due to self-inflicted wound.
Ova per gram	0	21,050	3,750	6,450	
Ova, reduced to "formed basis"	0	21,050	3,750	6,450	
Ova per female, by region	0	679	121	208	

[a] Total parasites found, 34 males and 31 females. [b] Mushy. [c] Formed.

TABLE 5.—*Showing egg counts in case 9, A.F.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	[b]	[c]	[c]	[c]	Death due to pulmonary œdema and hydropleura, secondary to dilatation of beriberic heart.
Ova per gram	0	3,150	6,300	1,050	
Ova, reduced to "formed basis"	0	3,150	6,300	1,050	
Ova per female, by region	0	315	630	105	

[a] Total parasites found, 9 males and 10 females. [b] Mushy. [c] Formed.

TABLE 6.—*Showing egg counts in case 10, L.O.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	(b)	(c)	(c)	(c)	Typhoid with intestinal hæmorrhage.
Ova per gram	100	3,825	1,575	1,875	
Ova, reduced to "formed basis"	400	7,650	3,150	3,750	
Ova per female, by region	200	3,825	1,575	1,875	

[a] Total parasites found, 3 males and 2 females. [b] Diarrhœal. [c] Mushy.

TABLE 7.—*Showing egg counts in case 11, P.C.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	(b)	(c)	(c)	(c)	Acute anæmia due to postpartum hæmorrhage.
Ova per gram	0	450	450	300	
Ova, reduced to "formed basis"	0	450	450	300	
Ova per female, by region	0	150	150	100	

[a] Total parasites found, 2 males and 3 females. [b] Mushy. [c] Formed.

TABLE 8.—*Showing egg counts in case 12, P.S.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	(b)	(b)	(b)	(b)	Typhoid fever with intestinal hæmorrhage.
Ova per gram	0	75	75	0	
Ova, reduced to "formed basis"	0	150	150	0	
Ova per female, by region	0	150	150	0	

[a] Total parasites found, 3 males. [b] Mushy.

TABLE 9.—*Showing egg counts in case 13, A.S.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	(b)	(b)	(b)	(b)	Amœbic abscess of the right lobe of the liver, extending into the right lung, and chronic ulcerative colitis.
Ova per gram	0	825	225	600	
Ova, reduced to "formed basis"	0	1,650	450	1,200	
Ova per female, by region	0	825	225	600	

[a] Total parasites found, 1 male and 2 females. [b] Mushy.

TABLE 10.—*Showing egg counts in case 14, L.I.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	(b)	(b)	(b)	(c)	Suppurative leptomeningitis due to pneumococcus.
Ova per gram	0	2,475	525	750	
Ova, reduced to "formed basis"	0	4,950	1,050	750	
Ova per female, by region	0	4,950	1,050	750	

[a] One female parasite found. [b] Mushy. [c] Formed.

TABLE 11.—*Showing egg counts in case 15, M.N.H.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	(b)	(c)	(c)	(c)	Autopsy findings, meningeal congestion and œdema with subdural and meningeal hæmorrhage. A case of insanity. Colon packed with no less than 2 kilograms of dry stool in the form of balls, in the sigmoid and rectum.
Ova per gram	0	600	1,350	0	
Ova, reduced to "formed basis"	0	600	1,350	0	
Ova per female, by region	0	150	340	0	

[a] Total parasites found, 2 males and 4 females. [b] Mushy. [c] Formed.

TABLE 12.—*Showing egg counts in case 16, V.F.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	(b)	(c)	(c)	(c)	Acute gastroenterocolitis in ptomain poisoning. Diarrhœa and vomiting, stopped two days before death by opiates. Patient said to be demented.
Ova per gram	0	850	150	0	
Ova, reduced to "formed basis"	0	1,700	300	0	
Ova per female, by region	0	566	100	0	

[a] Total parasites found, 2 males and 3 females. [b] Diarrhœal. [c] Mushy.

TABLE 13.—*Showing egg counts in case 17, L.L.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	[b]	[c]	[c]	[c]	Sudden death, due to cerebral hæmorrhage.
Ova per gram	0	1,425	450	1,425	
Ova, reduced to "formed basis"	0	1,425	450	1,425	
Ova per female, by region	0	142	45	142	

[a] Total parasites found, 7 males and 10 females. [b] Mushy. [c] Formed.

TABLE 14.—*Showing egg counts in case 18, M.A.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	[b]	[b]	[b]	[b]	Acute anæmia due to deep incised wound of the neck.
Ova per gram	0	300	300	75	
Ova, reduced to "formed basis"	0	600	600	150	
Ova per female, by region	0	300	300	75	

[a] Two female parasites found. [b] Mushy.

ASCARIASIS: RELATION BETWEEN THE NUMBER OF OVA PER GRAM OF FORMED STOOL AND THE NUMBER OF FEMALE WORMS HARBORED BY THE HOST

By C. MANALANG

Of the Philippine Health Service, Manila

These observations were carefully made on clinical and autopsy cases studied previously under ancylostomiasis. The egg-counting method and autopsy procedure are described in the two articles in this series on ancylostomiasis.[1] Due to the migratory habits of *Ascaris*, attention in clinical cases was directed to the vomiting up of the parasites, and in the morgue the stomach, trachea, and œsophagus were examined. Due to the freshness and lightness of infection in the cadavers studied, migrations were not observed. Only adult female worms were considered in this study and they were identified by their large size and by the presence of ova in their uteri. The males were identified by the curved caudal end, their smaller size, and the spicules.

The clinical cases are submitted only for the purpose of showing the variability of egg counts. The number of worms recovered cannot be taken to represent any definite percentage of the total harbored. Many of the worms were expelled in the second twenty-four-hour stools; collection of forty-eight-hour-treatment stools was the rule, except when the patient passed no stool in the second twenty-four hours, in which case the third twenty-four-hour stools were collected. It was likely, therefore, that some worms were lost after the forty-eighth hour.

The treatment administered was oil of chenopodium, described in the first article on ancylostomiasis, and the control counts were made four to five days after the treatment.

One of the objects of these observations was to determine the *Ascaris* egg factor per gram of stool, "formed basis," per adult female worm.

Examination of the clinical cases (Table 1) shows that case 1, which discharged at least 1 adult female worm, showed no ova

[1] Philip. Journ. Sci. 33 (1927) 35–65.

in the pretreatment count. Very likely there were a few, though they were not encountered.

Case 6 had 4,800 pretreatment and 4,350 posttreatment ova per gram, "formed basis," in spite of the discharge of at least 7 adult worms (not classified as to sex); this suggests an apparent acceleration of egg production by the remaining females after treatment.

Case 9 showed 47,300 pretreatment and 47,025 posttreatment ova per gram of stool, in spite of the removal of 13 adult females by treatment. (Compare with case 6.)

Tables 2 to 9 show the data from the eleven autopsy cases, of which five (cases 2, 5, 6, 10, and 11) could be considered normal controls due to the absence of intestinal pathology, and 6 (cases 1, 3, 4, 7, 8, and 9), pathological controls.

The total number of ova in five control cases by region (seventeen regions) is 63,925. In cases 5, 6, 10, and 11 the total number of female worms found was multiplied by 4, because they were counted regionally. The total number of female worms thus computed for seventeen regions is 45, or about 1,420 ova per gram of stool, "formed basis," per female. This may be taken as the egg factor for this series of normal controls. By the same computation, cases 1, 3, 4, 7, 8, and 9 (cases with intestinal pathology) gave 24,800 ova and 17 female worms for fifteen regions, or 1,460 ova per gram of stool per female.

Using the *Ascaris* egg factor of 1,420, obtained in the series without intestinal pathology, the following points become evident in the cases studies: Cases 3, 4, and 7, which gave no egg counts, might be explained as due to the continuous elimination of the intestinal contents, hæmorrhage in typhoid in cases 3 and 7, and diarrhœa in a child (case 4), a mechanical cause of the disapperance of the ova. It is rather unlikely that ovolysis took place in the typhoid cases as the eggshell [2] is of a resistant nature, and in view of the opposite finding in case 8, also of typhoid fever. Biological factors seemed at work on cases 6, 8, 9, and 11 (with high counts) and on case 5 (with no count). That no ova were found in cases 3, 4, and 7 may also have been due to poor egg laying. Case 6, with 4,200, 3,400, 1,750, and 4,750 ova per gram of stool in the ileum, cæcum, transverse, and sigmoid, respectively, to the one female found, died a violent death. Case 11 also, whose counts were as high

[2] Manalang, C., Philip. Journ. Sci. 33 (1927) 249–255.

as those of case 6, died of violence. Cases 8 and 9 (even in the presence of typhoid fever with hæmorrhage in the former and ptomain poisoning in the latter) both showed high counts (see Tables 6 and 7). Case 2 (without intestinal pathology) gave only 325 ova per gram of rectal stool to the female. Case 5 (a case of ascariasis intoxication (?) in an infant) showed no ova in the rectal stool from the 2 adult females found. Case 10 showed 625, 637, 975, and 1,637 ova per gram of stool from the ileum, cæcum, transverse, and sigmoid, respectively, for every female found. This is possible evidence of dehydration of the stools containing even numbers of ova. Case 1 (with intestinal obstruction) gave a slightly higher count than normal.

SUMMARY

1. *Ascaris* egg counts were made on clinical and autopsy cases, in conjunction with hookworm studies.

2. Eleven clinical cases and eleven autopsy cases were studied and special care was taken not to lose any adult worms.

3. The clinical cases showed unreasonable discrepancies between pretreatment and posttreatment counts in some cases.

4. Of the eleven autopsy cases, five were cases without organic or evident functional pathology of the intestines, and six had pathologic alimentary tracts.

5. The egg factor per gram of stool, "random" specimen, reduced to "formed basis" per female, was found to be about 1,420 for the five normal cases, computed on seventeen intestinal regions.

6. Six cases with intestinal pathology gave an average of 1,460 ova per gram per female, computed on fifteen regions.

7. Mechanical and biological factors were apparently responsible for the variation of egg counts observed between cases and in the same case when the regions were analyzed in the light of the actual number of adult female worms found and of the egg factor.

8. Egg destruction in vivo cannot be considered a factor in producing variation in the number of ova in pathological controls due to the resistant nature of the shell.

TABLE 1.—*Showing the data obtained from the eleven clinical cases.*

Serial No. of patient.	Name.	Type of stool.[a]	Ova per gram.	Ova reduced to "formed basis."	Parasites recovered.			Type of stool.[a]	Ova per gram.	Ova reduced to "formed basis."	Remarks.
					Male.	Female.	Total.				
1	V.J.	M	0	0	0	1	1	F	0	0	Very few eggs produced in an adult female worm.
2	M.R.	M	7,575	15,150	(b)	(b)	12	M	0	0	
3	G.S.	D	450	1,800	(b)	(b)	3	F	0	0	
4	D.O.	D	150	600	0	0	0	F	0	0	Worm may have been discharged after forty-eight hours, or retained but producing less ova after treatment.
5	T.V.	D	525	2,100	(b)	(b)	4	F	0	0	
6	A.F.	D	1,200	4,800	(b)	(b)	7	F	4,350	4,350	No decrease in egg count, in spite of the effect of the vermifuge.
7	G.L.	M	225	450	0	0	0	F	0	0	Worms either lost or there was decreased production of ova.
8	A.T.	M	1,200	2,400	5	2	7	(c)	(c)	(c)	
9	L.S.	F	47,300	47,300	3	13	16	F	47,025	47,025	No decrease in egg count, in spite of the effect of the vermifuge.
10	E.G.	D	375	1,500	0	1	1	F	10	0	
11	D.R.	D	2,175	8,700	1	3	4	F	0	0	

[a] M, mushy; D, diarrhœal; F, formed.

[b] Not classified.

[c] Positive for ova not counted.

TABLE 2.—*Showing egg counts in cases 1 to 4, inclusive.*

Serial No. of patient.	Name.	Type of stool.	Ova per gram.	Ova reduced to "formed basis."	Parasites found.		Ova per gram per female.	Remarks.
					Male.	Female.		
1	M.A.	F	3,750	3,750	1	2	1,875	Cause of death, intestinal obstruction. Fæcal fistula one week before death.
2	B.L.	F	325	325	0	1	325	Broncho-pneumonia.
3	W.G.	M	0	0	3	2	(?)	Typhoid fever with intestinal hæmorrhage.
4	G.F.	M	0	0	0	1	(?)	Catarrhal enterocolitis in a child.

TABLE 3.—*Showing egg counts in case 5, H.A.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	(b)	(c)	(c)	(c)	Autopsy findings, multiple punctate hæmorrhages in the brain with meningeal congestion and œdema, possibly due to ascariasis. Patient was a child of 13 months.
Ova per gram	0	0	0	0	
Ova per gram reduced to "formed basis"	(?)	(?)	(?)	(?)	
Ova per female, by region	(?)	(?)	(?)	(?)	

[a] Total parasites found, 4 males and 2 females. [b] Mushy. [c] Formed.

TABLE 4.—*Showing egg counts in case 6, B.F.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	(b)	(c)	(c)	(c)	Death due to acute anæmia and hæmorrhage, due to self-inflicted wound.
Ova per gram	2,100	3,400	1,750	4,750	
Ova per gram reduced to "formed basis"	4,200	3,400	1,750	4,750	
Ova per female, by region	4,200	3,400	1,750	4,750	

[a] Total parasites found, 1 male and 1 female. [b] Mushy. [c] Formed.

TABLE 5.—*Showing egg counts in case 7, L.O.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	(b)	(c)	(c)	(c)	Typhoid fever with intestinal hæmorrhage.
Ova per gram	0	0	0	0	
Ova per gram reduced to "formed basis"	(?)	(?)	(?)	(?)	
Ova per female, by region	(?)	(?)	(?)	(?)	

[a] One female parasite found. [b] Diarrhœal. [c] Mushy.

TABLE 6.—*Showing egg counts in case 8, P.S.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	(b)	(b)	(b)	(b)	Typhoid fever with intestinal hæmorrhage.
Ova per gram	0	1,200	2,400	3,000	
Ova per gram, reduced to "formed basis"	(?)	2,400	4,800	6,000	
Ova per female, by region	(?)	2,400	4,800	6,000	

[a] Total parasites found, 1 male and 1 female. [b] Mushy.

TABLE 7.—*Showing egg counts in case 9, V.F.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	(b)	(c)	(c)	(c)	Ptomain poisoning.
Ova per gram	150	1,650	1,675	300	Diarrhœa stopped two days before death.
Ova per gram, reduced to "formed basis"	600	3,300	3,350	600	
Ova per female, by region	600	3,350	3,350	600	

[a] Total parasites found, 1 male and 1 female. [b] Diarrhœal. [c] Mushy.

TABLE 8.—*Showing egg counts in case 10, L.L.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	(b)	(c)	(c)	(c)	Sudden death due to cerebral hæmorrhage in a case with arteriosclerosis, chronic interstitial nephritis, and hypertrophy of the left ventricle.
Ova per gram	1,875	3,825	5,850	9,825	
Ova per gram, reduced to "formed basis"	3,750	3,825	5,850	9,825	
Ova per female, by region	625	637	975	1,637	

[a] Total parasites found, 5 males and 6 females. [b] Mushy. [c] Formed.

TABLE 9.—*Showing egg counts in case 11, M.A.*[a]

	Stool from—				Remarks.
	Ileum.	Cæcum.	Transverse.	Sigmoid or rectum.	
Type of stool	(b)	(b)	(b)	(b)	Acute anæmia due to deep incised wound in the neck, severing the right jugular and carotid.
Ova per gram	2,625	2,175	2,550	5,775	
Ova per gram, reduced to "formed basis"	5,250	4,350	5,100	11,550	
Ova per female, by region	2,625	2,175	2,550	5,775	

[a] Total parasites found, 2 males and 2 females. [b] Mushy.

THREE NEW PHILIPPINE FISHES

By Albert W. Herre

Chief, Division of Fisheries, Bureau of Science, Manila

THREE PLATES

BELONIDÆ

TYLOSURUS PHILIPPINUS Herre, sp nov.

Dorsal II–18 or 19; anal II–18 or 19 or I–20; pectoral 14 or 15; ventral 6; lateral line about 194 + 10; about 22 scales between original of dorsal and lateral line.

The compressed elongate body roughly pentagonal, head nearly triangular in cross section; depth 11.25 to 11.3 in length, breadth of body 1.56 to 1.6 in its own depth, which is greatest just before dorsal; head 2.88 to 2.93 in length, its flat upper surface with a wide, deep median channel and a small, narrow, elongate groove on each side of it; space between these and outer margin of interorbital with longitudinally divergent striæ; the median channel narrows abruptly anteriorly and is prolonged in a narrow median groove to tip of beak; the large lateral eye placed high up, 9 to 10 in head, 2.68 to 2.75 in postorbital part of head, 1.25 to 1.375 in interorbital, 6 to 6.25 in snout; the strong mandible 1.36 to 1.44 in head, extending beyond end of snout in a thick, spongy, somewhat flexible tip, which rises above so that upper jaw rests upon it and dorsal profile of latter is continuous with that of lower jaw tip when mouth is closed; upper margin of mandible, except its fleshy tip, in line with middle of pupil of eye; mouth abundantly supplied with long, strong, needle-pointed, vertical canines, those of lower jaw outside upper jaw when mouth is closed, tongue smooth except margin of posterior constricted part, which has some hard tubercles; fourth upper pharyngeals not distinct from third; maxillary not entirely hidden by preorbital; preopercle entirely covered with fine scales, opercle and top of head naked; pectorals broad, 3.3 to 3.5 in head; ventrals a little shorter than pectorals, more or less falciform; origin of dorsal opposite first undivided ray; anterior dorsal and anal rays elongate, equal to pectoral or a fourth longer, the dorsal rays longest in one specimen, the anal

rays in two specimens; dorsal height 3 to 3.2 times, anal 3.5 to 2.66 times in head; caudal peduncle short, its breadth 1.62 in its depth; the lateral line forms a very low but distinct whitish keel on caudal peduncle; caudal very badly damaged in the type specimens, about 2.5 in head, lower caudal lobe longer than upper one.

Color in alcohol brownish above, silvery below, opercles and underside of head white. Fins colorless except upper half of dorsal, which is dusky.

Here described from the type, No. 11,084 Bureau of Science collection, 452 millimeters long, and the cotype, 462 millimeters long, collected at Coron, Busuanga. I also have a specimen, 435 millimeters long, from Tandubas Island and one, 390 millimeters long, from Sitankai, both in Sulu Province. I have compared these fishes with all the material in the United States National Museum and at Stanford University and find nothing there like them. The singular beak almost warrants the creation of a new genus for them. The cartilaginous tip is apparently a sense organ similar to that at the tip of a *Hemiramphus* beak.

Philippinus, from the Philippines.

BRANCHIOSTEGIDÆ

BRANCHIOSTEGUS ILOCANUS Herre, sp. nov.

Dorsal VII–14, first and second spines united; anal II–11; lateral line about 60; scales in transverse series 25.

The head and the tapering body flattened laterally, much thicker anteriorly, depth 3.6 in length; the large head thicker than trunk, 2.96 in total; head almost flat above, profile rounded as it descends over eye, snout very steep; dorsal profile straight and slightly descending from above head to caudal peduncle; anterior half of ventral line nearly straight, then curving upward to caudal peduncle; the very large lateral eye high up, the distance from its front margin to tip of snout approximately equal to distance from its rear margin to posterior extremity of opercle, 4.55 in head and 1.95 in the large prominent snout, which is 2.33 in head; interorbital very slightly exceeds eye in breadth, 4.33 in head, a longitudinal groove along its middle; cheek very broad, its depth approximately equal to snout; the oblique mouth rather large, lower jaw included, posterior extremity of maxillary reaching a vertical midway between posterior nostril and anterior margin of eye; teeth of upper jaw in two rows except anteriorly, where they are in four rows;

teeth of outer row much larger and stronger than the others, the last two teeth on each side hooked canines; teeth of lower jaw in one row except at symphysis, where they are in three rows: no reduced teeth in lower jaw, but those along middle of each side enlarged; 8 rows of scales on cheek, the three middle rows of enlarged scales; posterior margin of preopercle denticulate; scales extending forward on head to anterior portion of interorbital; body scaled everywhere, and fine scales extend on pectoral and more than half the length of caudal; no scales on suborbital, snout, jaws, and underside of head.

Origin of dorsal above pectoral base, first spine three-fourths of an eye diameter, second spine 1.5 times eye, the remaining spines and rays very gradually increasing until the next to the last, which is 2.65 times eye or a trifle more than 1.7 in head; anal resembles dorsal, the last few rays about equal, 1.75 times eye or 2.6 in head; depth of caudal peduncle 3 in head; caudal subtruncate, the uppermost rays longest, 1.44 in head or 4.28 in length; pectoral pointed, the central rays elongate, 1.33 times in head or 3.97 in length; the ray next below the longest, or seventh ray, not abruptly shortened as described by Snyder for *B. japonicus;* the narrow pointed ventrals fall far short of anus, 2 + times in head, 6 in length.

Color in alcohol dusky olive brown on top of head and along back, the sides and belly silvery; a black seam extends forward from base of dorsal to anterior extremity of interorbital space; suborbital and snout bright yellow, with a triangular orange spot on lower median portion of snout; a yellow band on base of dorsal, now almost entirely disappeared; a fine blackish marginal line on dorsal and upper margin of pectoral; anal, pectoral, and ventral colorless; an olive brown triangle covers lower third of caudal, its apex at lower side of caudal peduncle; a central longitudinal band of the same color, and a marginal line of olive brown above; remainder of fin yellowish.

Here described from a specimen, 270 millimeters long, purchased in the market at Narvacan, Ilocos Sur Province, Luzon.

Ilocanus, from Ilocos.

CALLIONYMIDÆ

SYNCHIROPUS TENTACULATUS Herre, sp. nov.

Dorsal IV–8; anal 7.

Body rounded, wedge-shaped, with wide head and slender snout, depth 5.3 to 5.5 in length; head a third to a half wider

than deep, wider than body, 2.9 to 3.1 in length; the large dorsolateral eyes surrounded, except below, by a bony rim, prominent anteriorly, 3 to 3.25 in head; in females the concave snout scarcely equals eye; in males the snout is longer, 2.75 in head; mouth terminal, upper jaw protractile, posterior extremity of maxillary not extending to anterior margin of eye; the narrow interorbital 5 to 6 in eye; the preopercle has a strong, backward-projecting spine, a little shorter than eye, with a spine on inner side near its tip and a small downward-projecting spine farther forward on its outer side; a threadlike tentacle on each eye, just inside upper posterior margin, its length nearly equal to an eye diameter; two circular bony plates covered with toothlike asperities on occipital region, each half an eye diameter; first dorsal low, first spine highest, 2.5 in head in females, 1.85 in males; second dorsal very little higher than first in the female, first and second rays longest, 2.2 in head; in the male the anterior dorsal rays high, the others successively shorter except the last which is a little the longest, 1.57 in head, extending to base of caudal; anal like second dorsal, but scarcely as high in the female; in the male anal low except the last two rays which are much elongated, extending upon caudal, 1.22 in head; the narrow subtruncate caudal slightly exceeds head in the female, 2.66 in length; it is much longer in the male, more than half again as long as head, 1.9 times in length; the broad ventrals longer than pectorals, extending to or beyond origin of anal, equal to head in the male, a tenth shorter in the female, the outer rays less than half the length of the inner ones; central rays of pectoral much longer than the others, forming a pointed lobe extending beyond origin of anal, 1.5 in head in the female, 1.37 in the male; a slender pointed anal papilla present in the male.

Color in alcohol dark wine red with purplish luster, snout paler, belly whitish; tentacle wine red; spinous dorsal pale wine red, soft dorsal much paler; anal with two longitudinal rows of dusky or dark brown spots on outer half; caudal with three transverse rows of black spots in the male, brown in the female, the lower ray with several dark spots; male with sides of snout, cheeks, eye, upper side of ventrals, basal half of pectorals, and basal portion of caudal with beautiful irregular pearl-colored spots; both male and female have the upper side of ventrals red like body, with several circular black dots sprinkled on it; pectorals brown, with many obscure crossbars.

Here described from the type, No. 7302 Bureau of Science collection, a male, 34.5 millimeters long, the caudal 18 millimeters long, and a female cotype, 32 millimeters long. Both were obtained at Puerto Galera, Mindoro, by Alvin Seale, in May, 1912.

I can find no record in the accessible literature of a callionymid fish with tentacles upon its eyes. This seems to be a unique character in this group.

Tentaculatus, having tentacles.

ILLUSTRATIONS

PLATE 1

Synchiropus tentaculatus sp. nov., male. (Drawing by José L. Nievera.)

PLATE 2

FIG. 1. *Tylosurus philippinus* sp. nov.; × ⅓. (Drawing by P. Bravo.)
2. *Tylosurus philippinus* sp. nov.; × 1⅓. (Drawing by P. Bravo.)

PLATE 3

Branchiostegus ilocanus sp. nov. (Drawing by José L. Nievera.)

PLATE 1. SYNCHIROPUS TENTACULATUS SP. NOV., MALE.

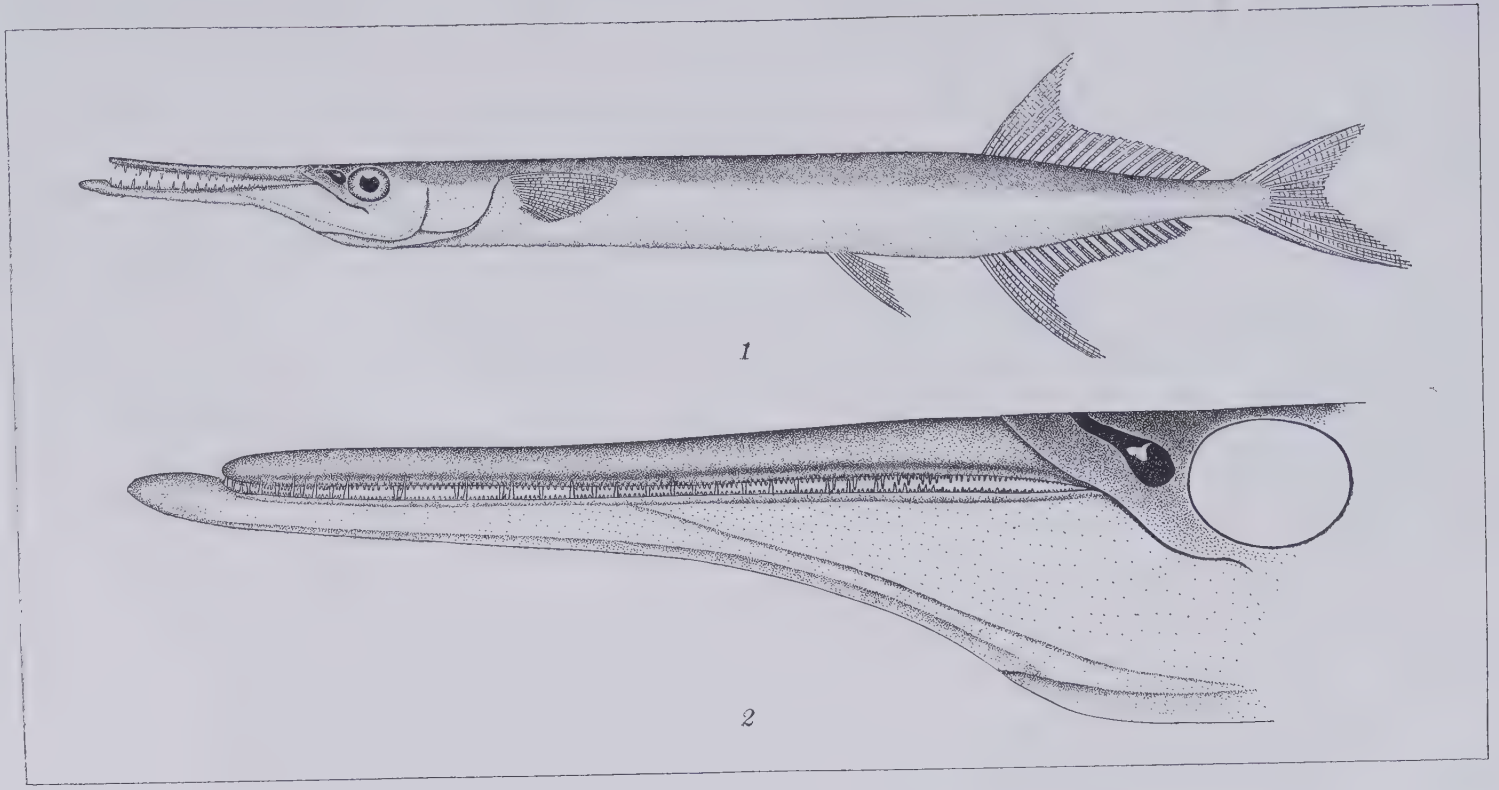

PLATE 2. TYLOSURUS PHILIPPINUS SP. NOV.

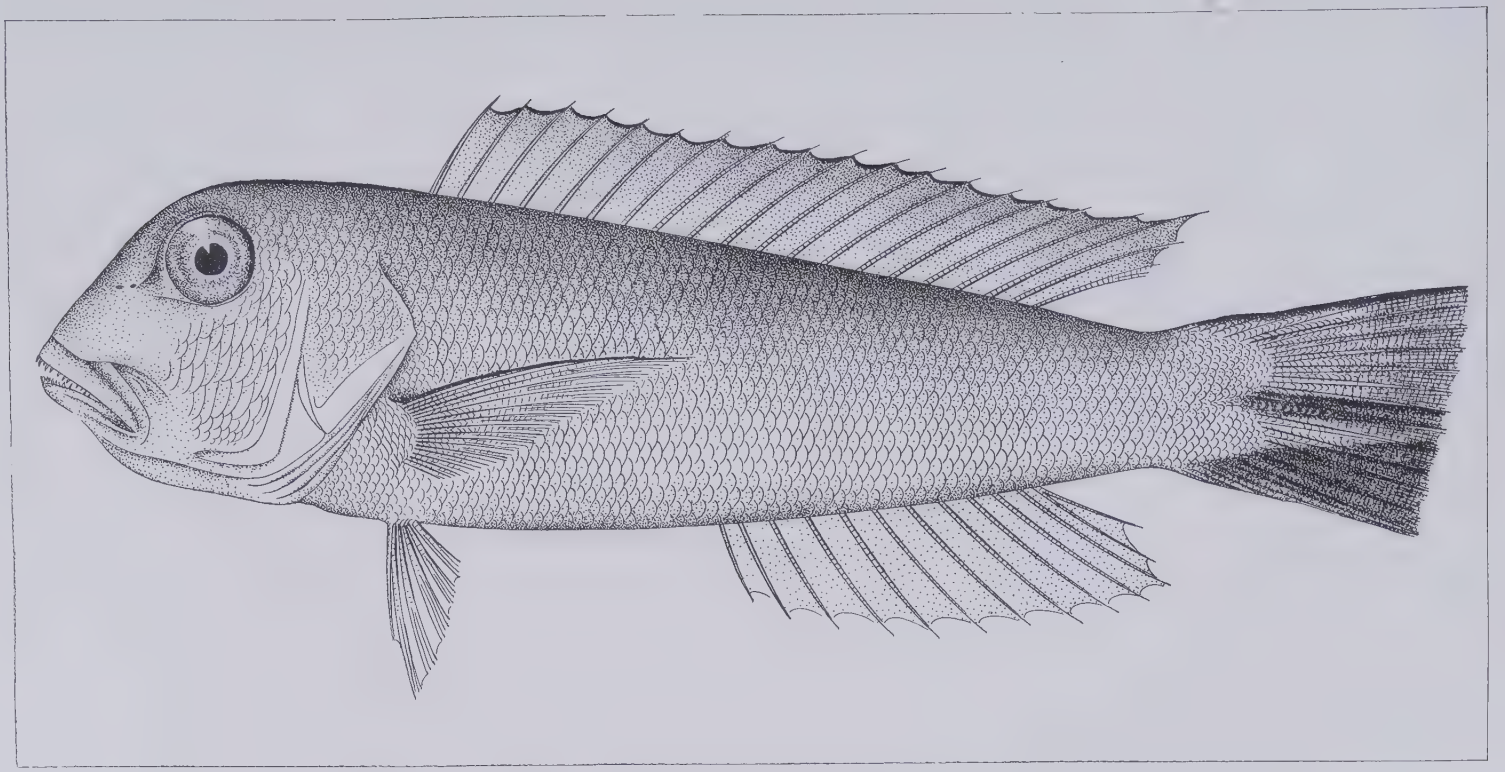

PLATE 3. BRANCHIOSTEGUS ILOCANUS SP. NOV.

DIATOMS FROM KHINGAN, NORTH MANCHURIA, CHINA

By B. W. Skvortzow

Of Harbin, Manchuria

FIVE PLATES

During my visit to the western part of North Manchuria in 1922, I made some collections of diatoms in Khingan Mountains in the environs of the Fuleierdi Railway Station. One of all samples was gathered in a small stream among the *Fontinalis* sp. stems and inspection of it yielded a considerable number of forms, of which I give here an enumeration, that may serve as a contribution to the history of the geographical distribution of these small organisms.

Very little attention has until recently been bestowed upon diatoms of Manchuria. They are listed in two of my notes which appeared during the last two years.[1] In the present paper I give the figures of nearly all forms listed here, some of which seem to be new to science.

Among those of special interest may be noted *Fragilaria hinganensis* sp. nov.; a species allied to *F. capucina* Desmazieres, *Frustulia vulgaris* Thw. var. *asiatica* var. nov., *Pinnularia episcopalis* Cleve var. *manschurica* var. nov.

The forms of diatoms found in the collection are herein enumerated.

MELOSIRA VARIANS Agerth. Plate 1, fig. 1.

Frustules cylindrical, in long filaments, slightly constricted on each side of the suture. Length, 0.025 millimeters; breadth, 0.050.

MELOSIRA DISTANS Kützing. Plate 1, fig. 2.

Frustules cylindrical. Puncta in longitudinal rows. Length, 0.038 to 0.035 millimeter; breadth, 0.0051 to 0.0187.

[1] Beiträge zur Kenntnis der Mandschurischen Diatomaceen, Nuova Notarisia Ser. XXXVI (1925), and Ueber einige Süsswasseralgen aus der Nord Mandschurei im Jahre 1916 gesammelt, Archiv für Hydrobiologie, No. 3 16 (1926).

MELOSIRA ITALICA Kützing. Plate 1, figs. 3, 4.

Frustules cylindrical. Puncta in spiral rows. Length, 0.025 to 0.0359 millimeter; breadth, to 0.006. Margins of valves denticulate at the junction of the frustules.

MELOSIRA ITALICA var. GENUINA forma TENUIS (Kützing) O. Müller. Plate 1, fig. 5.

Frustules, 0.005 millimeter in breadth.

TABELLARIA FLOCCULOSA Kützing. Plate 1, fig. 6.

Valve linear, with median inflation larger than terminal. In zone view the frustules are quadrangular. Length, 0.035 millimeter; breadth, 0.009.

TABELLARIA FENESTRATA (Lyngb.) Kützing. Plate 1, fig. 7.

Valve elongated; pseudoraphe narrow. Length, 0.0745 millimeter; breadth, 0.006.

MERIDION CONSTRICTUM Ralfs. Plate 1, fig. 8.

Valve with a capitate end. Length, 0.0323 millimeter; breadth, 0.0042. Striæ, 5 in 0.01 millimeter.

MERIDION CIRCULARE Agarth. Plate 1, fig. 9.

Frustules in zone view cuneate, adnate in circular or spiral fasciæ. Length, to 0.0493 millimeter; breadth, to 0.004. Striæ, 3 to 4 in 0.01 millimeter.

FRAGILARIA HINGANENSIS sp. nov. Plate 1, figs. 10 to 15.

Valve linear, apices slightly produced and subrostrate. Length, 0.0255 to 0.0655 millimeter; breadth, 0.0034. Zone view breadth, 0.0042 to 0.0068 millimeter. Striæ, 24 in 0.01 millimeter.

Found in long ribbon or fasciæ.

FRAGILARIA HINGANENSIS var. LONGISSIMA var. nov. Plate 1, figs. 16, 17.

Valve linear with subrostrate ends. Length, 0.085 to 0.136 millimeter; breadth, 0.0034. Zone view, 0.0051 to 0.0076 millimeter. Striæ, 24 in 0.01 millimeter.

Found in long ribbons.

SYNEDRA ULNA Ehrenberg. Plate 1, fig. 18.

Valve linear lanceolate, with rostrate apices. Interrupted in the middle. Length, 0.140 millimeter; breadth, 0.0068. Striæ, 9 in 0.01 millimeter.

SYNEDRA ULNA var. DANICA Kützing. Plate 1, figs. 19, 20.

Valve solitary or in twos, linear with rostrate apices. Length, 0.217 to 0.3589 millimeter; breadth, 0.0042. Striæ, 0.009 in 0.01 millimeter.

SYNEDRA ULNA var. AMPHIRRHYNCHUS Ehrenberg. Plate 1, figs. 21, 22.

Valve linear, with slightly capitate ends. Length, 0.238 millimeter; breadth, 0.006. Striæ, 9 in 0.01 millimeter.

SYNEDRA ULNA var. OXYRHYNCHUS Kützing. Plate 1, fig. 23.

Valve small linear, lanceolate with rostrate apices. Striæ not interrupted in the middle. Length, 0.085 millimeter; breadth, 0.0075. Striæ, 9 in 0.01 millimeter.

SYNEDRA ACUS Kützing var. DELICATISSIMA W. Smith. Plate 1, figs. 24, 25.

Valve free linear, lanceolate, slightly rostrate at the end. Length, 0.0731 to 0.1227 millimeter; breadth, 0.0028 to 0.003. Striæ 11 to 15 in 0.01 millimeter.

SYNEDRA ACUS var. ANGUSTISSIMA Grunow. Plate 1, fig. 26.

Valve free, lanceolate. Length, 0.170 millimeter; breadth, 0.0042. Striæ, 16 in 0.01 millimeter. Rare.

EUNOTIA PECTINALIS Kützing var. VENTRICOSA Grunow. Plate 2, fig. 1.

Valve tumid in the middle. Length, 0.0724 millimeter; breadth, 0.0055. Striæ 9 in 0.01 millimeter.

EUNOTIA PECTINALIS var. IMPRESSA O. Müller. Plate 2, fig. 2.

Valve with two undulations. Length, 0.0444 millimeter; breadth, 0.005. Striæ, 12 in 0.01 millimeter.

EUNOTIA PECTINALIS var. IMPRESSA forma CURTA Van Heurck. Plate 2, fig. 3.

Valve short, slightly curvate. Length, 0.0238 to 0.0255 millimeter; breadth, 0.0051. Striæ, 12 or 13 in 0.01 millimeter.

EUNOTIA LUNARIS Ehrenberg. Plate 2, figs. 4, 5.

Frustules sessile, solitary or in clusters. Valve arcuate, narrow, attenuated toward the apices, which are sometimes slightly rostrate or rostrate-capitate. Length, 0.0544 to 0.0867 millimeter; breadth, 0.0034 to 0.0036. Striæ, 12 in 0.01 millimeter.

COCCONEIS PLACENTULA Ehrenberg.

Valve elliptical; with a lanceolate axial area, radiating rows of puncta, and a wide border of finely punctate, radiating striæ, separated from the central part of the valve by a narrow hyaline zone. Length, 0.0187 to 0.0238 millimeter; breadth, 0.0102 to 0.0119.

DIPLONEIS PUELLA (Schum.) Cleve. Plate 2, fig. 6.

Valve elliptical. Length, 0.0221 millimeter; breadth, 0.012. Costæ, 14 or 15 in 0.01 millimeter.

NEIDIUM IRIDIS Ehrenberg. Plate 2, fig. 7.

Valve linear subelliptical, with rounded ends. Length, 0.136 millimeter; breadth, 0.0221. Striæ, 16 to 18 in 0.01 millimeter.

NEIDIUM IRIDIS var. AMPLIATA Ehrenberg. Plate 2, fig. 8.

Valve broadly elliptical, with subrostrate ends. Length, 0.0811 millimeter; breadth, 0.025. Striæ, 16 in 0.01 millimeter.

NEIDIUM IRIDIS var. FIRMA V. Heurck. Plate 2, fig. 9.

Valve linear. Length, 0.1037 millimeter; breadth, 0.0272. Striæ, 16 or 17 in 0.01 millimeter; puncta, 18 in 0.01 millimeter.

NEIDIUM AFFINE Ehrenberg var. GENUINA Cleve forma MEDIA Cleve. Plate 2, fig. 10.

Valve linear, with rostrate ends. Length, 0.128 millimeter; breadth, 0.0272. Striæ, 20 in 0.01 millimeter.

NEIDIUM AFFINE var. AMPHIRHYNCHUS Ehrenberg forma MANSCHURICA forma nova. Plate 2, fig. 11.

Valve with protracted, rostrate-capitate ends. Length, 0.0833 millimeter; breadth, 0.0255. Striæ, 24 in 0.01 millimeter.

FRUSTULIA VULGARIS Thwaites var. ASIATICA var. nov. Plate 2, fig. 12.

Valve lanceolate, with obtuse rounded ends. Length, 0.0527 millimeter; breadth, 0.0085. Striæ, 23 in 0.01 millimeter.

NAVICULA BACILLIFORMIS Grunow. Plate 2, fig. 13.

Valve linear, with broad, rounded ends. Length, 0.034 millimeter; breadth, 0.0102. Central area rectangular. Striæ, 15 to 17 in 0.01 millimeter.

NAVICULA RADIOSA Kützing var. MANSCHURICA var. nov. Plate 2, fig. 14.

Valve linear, obtuse. Length, 0.0766 millimeter; breadth, 0.008. Striæ, 9 in 0.01 millimeter, in the middle slightly radiate, elsewhere almost parallel.

NAVICULA PEREGRINA Ehrenberg. Plate 2, fig. 15.

Valve lanceolate, with obtuse ends. Length, 0.0901 millimeter; breadth, 0.017. Central area large. Striæ, 6 to 7 in 0.01 millimeter.

NAVICULA REINHARDII Grunow. Plate 2, fig. 16.

Valve elliptical, with broad obtuse ends. Length, 0.0731 millimeter; breadth, 0.017. Striæ, 8 in 0.01 millimeter.

NAVICULA CINCTA Ehrenberg var. LEPTOCEPHALA Ehrenberg. Plate 2, fig. 17.

Valve lanceolate, with slightly rostrate and obtuse ends. Length, 0.034 millimeter; breadth, 0.0069. Striæ, 9 in 0.01 millimeter.

NAVICULA sp. Plate 2, fig. 18.

Valve lanceolate, with rostrate and obtuse ends. Length, 0.039 millimeter; breadth, 0.0085. Striæ, 18 in 0.01 millimeter.

NAVICULA AMPHIBOLA Cleve var. MANSCHURICA var. nov. Plate 2, fig. 19.

Valve elliptic-lanceolate, with rostrate, truncate ends. Length, 0.0459 millimeter; breadth, 0.017. Central area rectangular. Striæ, 13 to 15 in 0.01 millimeter.

PINNULARIA MESOLEPTA Ehrenberg var. STAURONEIFORMIS Grunow. Plate 2, fig. 20.

Valve triundulated, with capitate ends. Length, 0.0663 millimeter; breadth, 0.0136. Striæ, 8 or 9 in 0.01 millimeter, strongly divergent in the middle and convergent at the ends.

PINNULARIA BREBISSONI Kützing var. DIMINUTA V. Heurck. Plate 2, fig. 21.

Valve linear-elliptical, with rounded ends. Length, 0.0272 millimeter; breadth, 0.0076. Area narrow. Striæ 16 in 0.01 millimeter, divergent in the middle and convergent toward the ends.

PINNULARIA NODOSA Ehrenberg var.? Plate 2, fig. 22.

Valve linear, with slightly triundulate margins, with rostrate ends. Length, 0.0663 millimeter; breadth, 0.0102. Median line filiform. Axial area wider than one-third of the breadth of the valve. Striæ, 8 in 0.01 millimeter, interrupted, divergent in the middle, convergent at the ends.

PINNULARIA LEGUMEN Ehrenberg. Plate 2, fig. 23.

Valve linear-lanceolate, with slightly triundulate margins and subrostrate, broad ends. Length, 0.0731 millimeter; breadth, 0.0102. Axial area broad, dilated in the middle. Striæ, 10 in 0.01 millimeter, divergent in the middle, convergent at the ends.

PINNULARIA EPISCOPALIS Cleve var. MANSCHURICA var. nov. Plate 3, figs. 1, 2.

Valve linear, with parallel margins or slightly gibbous in the middle. The ends broadly rounded. Length, 0.1571 to 0.289 millimeter; breadth, 0.033 to 0.0444. Striæ, 6 or 7 in 0.01 millimeter, strongly divergent in the middle and convergent at the ends.

PINNULARIA MAJOR Kützing. Plate 3, fig. 3.

Valve slender, linear, gibbous in the middle, and rounded at the ends. Length, 0.177 to 0.203 millimeter; breadth, 0.0255. Striæ, 6 or 7 in 0.01 millimeter.

PINNULARIA MAJOR forma MANSCHURICA forma nova. Plate 3, fig. 4.

Valve linear, slightly gibbous in the middle. Length, 0.150 to 0.159 millimeter; breadth, 0.020 to 0.0204. Striæ, 6 or 7 in 0.01 millimeter.

PINNULARIA VIRIDIS Nitzsch. Plate 3, fig. 5.

Valve elliptic-linear, with parallel margins. Length, 0.111 to 0.1139 millimeter; breach, 0.0187 to 0.0204. Striæ, 6 or 7 in 0.01 millimeter, slightly divergent in the middle and convergent at the ends.

PINNULARIA VIRIDIS var. INTERMEDIA Cleve. Plate 3, fig. 6.

Valve linear, with parallel margins, attenuated toward the rounded ends. Length, 0.0629 millimeter; breadth, 0.012. Striæ, 8 in 0.01 millimeter, divergent in the middle, convergent at the ends.

PINNULARIA NOBILIS Ehrenberg var. INTERMEDIA Dippel. Plate 3, fig. 7.

Valve linear, slightly gibbous in the middle and at the broadly rounded ends. Length, 0.240 millimeter; breadth, 0.0296. Median line complex. Striæ, 5 or 6 in 0.01 millimeter, divergent in the middle, convergent at the ends.

PINNULARIA NOBILIS var. MANSCHURICA var. nov. Plate 3, fig. 8.

Valve linear, with parallel margins and broadly rounded ends. Length, 0.374 millimeter; breadth, 0.0425. Median line complex. Axial area broad. Striæ, 5 or 6 in 0.01 millimeter, divergent in the middle, convergent at the ends.

PLEUROSTAURON ACUTA W. Smith. Plate 2, fig. 24.

Valve rhombic-lanceolate, gradually tapering from the middle to the narrow obtuse ends. Length, 0.136 millimeter; breadth, 0.0238. Striæ, 11 or 12 in 0.01 millimeter.

STAURONEIS PHOENICENTERON Ehrenberg var. GENUINA Cleve forma. Plate 2, fig. 25.

Valve lanceolate, with obtuse ends. Length, 0.1479 millimeter; breadth, 0.0323. Stauros not reaching to the margin. Striæ radiate throughout, 13 or 14 in 0.01 millimeter, distinctly punctate.

STAURONEIS PHOENICENTERON var. GENUINA Cleve. Plate 2, fig. 26.

Valve lanceolate, with obtuse ends. Length, 0.1496 millimeter; breadth, 0.0272. Stauros linear, reaching the margin. Striæ, 12 or 13 in 0.01 millimeter.

STAURONEIS PHOENICENTERON var. AMPHILEPTA Ehrenberg. Plate 2, fig. 27.

Length, 0.0935 millimeter; breadth, 0.007. Stauros linear. Striæ, 18 in 0.01 millimeter.

STAURONEIS PHOENICENTERON var. VULGARIS Dippel forma INTERMEDIA Dippel. Plate 2, fig. 28.

Valve lanceolate, with slightly capitate ends. Length, 0.0918 millimeter; breadth, 0.0187. Striæ, 15 to 17 in 0.01 millimeter.

GOMPHONEMA ACUMINATUM Ehrenberg var. CORONATA Ehrenberg. Plate 2, fig. 29.

Valve clavate, biconstricted, with broad, apiculate apex. Length, 0.0544 millimeter; breadth, 0.0153. Striæ, 10 in 0.01 millimeter.

GOMPHONEMA ACUMINATUM var. BREBISSONII Kützing. Plate 2, figs. 30, 31.

Valve slightly biconstricted, with cuneate apex. Length, 0.0306 to 0.0476 millimeter; breadth, 0.0068 to 0.0085. Striæ, 9 or 10 in 0.01 millimeter.

GOMPHONEMA ACUMINATUM var. TRIGONOCEPHALA Ehrenberg. Plate 2, fig. 32.

Valve not distinctly biconstricted. Apex cuneate. Length, 0.0255 millimeter; breadth, 0.0068. Striæ, 10 or 11 in 0.01 millimeter.

GOMPHONEMA PARVULUM Kützing var. MICROPUS Kützing. Plate 3, fig. 9.

Valve slightly clavate, lanceolate, with obtuse apex and subacute basis. Length, 0.0153 millimeter; breadth, 0.0051. Striæ, 11 in 0.01 millimeter.

GOMPHONEMA CONSTRICTUM Ehrenberg var. CAPITATA Ehrenberg. Plate 3, fig. 10.

Valve very slightly constricted, clavate with broad apex. Length, 0.0326 millimeter; breadth, 0.012. Striæ, 9 in 0.01 millimeter.

GOMPHONEMA CONSTRICTUM forma CURTA Grunow. Plate 3, fig. 11.

Valve length, 0.030 millimeter; breadth, 0.012. Striæ, 9 in 0.01 millimeter.

GOMPHONEMA SPHAEROPHORUM Ehrenberg. Plate 3, fig. 12.

Valve clavate, with capitate apex and narrow basis. Length, 0.0391 millimeter; breadth, 0.0085. Central area small. Striæ, 10 in 0.01 millimeter.

GOMPHONEMA GEMINATUM Lyngb. Plate 2, figs. 13, 14.

Valve strongly biconstricted, with broad, subtruncate apex and basis. Length, 0.1185 to 0.1258 millimeter. Central area with two to five stigmas, disposed in a longitudinal row on one side of the central nodule. Striæ, 8 in 0.01 millimeter.

CYMBELLA ASPERA Ehrenberg. Plate 4, figs. 1, 2.

Valve broad, with strongly arcuate dorsal margin, and straight, centrally gibbous ventral margin. Ends obtuse, rounded. Length, 0.148 to 0.180 millimeter; breadth, 0.030 to 0.035. Median line arcuate. Axial area linear, slightly dilated in the middle. Striæ in the middle, 8 in 0.01 millimeter, slightly radiate, punctate; puncta, 12 to 15 in 0.01 millimeter, in the end, 9 to 11 in 0.01 millimeter.

CYMBELLA ASPERA var. ELONGATA var. nov. Plate 4, fig. 4.

Valve length, 0.192 to 0.340 millimeter; breadth, 0.037 to 0.045. Striæ, 8 or 9 in 0.01 millimeter. Puncta, 12 to 15 in 0.01 millimeter.

CYMBELLA ASPERA var. MANSCHURICA var. nov. Plate 4, fig. 5.

Valve length, 0.114 to 0.325 millimeter; breadth, 0.0259 to 0.0444. Median line arcuate. Axial area linear, slightly dilated in the middle. Striæ in the middle, 7 to 9 in 0.01 millimeter; in the end, 9 to 10 in 0.01 millimeter. Puncta 7 to 10 in 0.01 millimeter.

CYMBELLA CUSPIDATA Kützing. Plate 3, figs. 15, 20.

Valve broadly linear-lanceolate, with rostrate-capitate ends. Length, 0.0408 to 0.0969 millimeter; breadth, 0.0153 to 0.0306. Striæ, 8 to 10 in 0.01 millimeter.

CYMBELLA HETEROPLEURA Ehrenberg. Plate 5, fig. 1.

Valve broadly linear lanceolate, slightly asymmetrical with rostrate ends. Length, 0.136 millimeter; breadth, 0.0323. Central area large. Striæ, 7 or 8 in 0.01 millimeter. Puncta, 15 in 0.01 millimeter.

CYMBELLA TUMIDA Brebisson var. BOREALIS Grunow. Plate 5, fig. 2.

Valve boat-shaped, with slightly gibbous ventral margin. Ends obliquely truncate, not rostrate. Length, 0.0731 millimeter; breadth, 0.0221. Striæ, 9 in 0.01 millimeter.

CYMBELLA CISTULA Hemprich. Plate 5, fig. 3.

Valve boat-shaped, with concave, slightly gibbous ventral margin and rounded obtuse ends. Length, 0.0799 to 0.0935 millimeter; breadth, 0.0221. Striæ, 7 in 0.01 millimeter. A distinct row of three puncta occurs below the median line.

CYMBELLA CISTULA var. MANSCHURICA var. nov. Plate 5, fig. 4.

Valve cymbiform, with gibbous ventral margin and truncate apices. No row of puncta on the ventral side of the central nodule. Length, 0.0697 millimeter; breadth, 0.017. Striæ, 8 in 0.01 millimeter.

CYMBELLA CISTULA var. HINGANENSIS var. nov. Plate 5, fig. 5.

Length, 0.158 millimeter; breadth, 0.0255. Striæ, 5 to 6 in 0.01 millimeter. A distinct row of four puncta occurs below the median line.

CYMBELLA VENTRICOSA Kützing. Plate 3, figs. 16 to 18.

Valve lunate, with gibbous ventral margin and subacute ends. Length, 0.0238 to 0.024 millimeter; breadth, 0.0085. Axial area narrow. Striæ, 8 to 10 in 0.01 millimeter.

AMPHORA OVALIS Kützing var. LIBYCA Ehrenberg. Plate 3, fig. 19.

Valve lunate. Length, 0.0493 millimeter; breadth, 0.0221. Central area frequently uniting with an irregular black band across the striæ. Striæ on the dorsal side, 10 to 11 in 0.01 millimeter.

EPITHEMIA SOREX Kützing. Plate 5, fig. 6.

Valve curvate short, strongly arcuate. Ends capitate. Length, 0.0357 millimeter; breadth, 0.0102. Striæ, 6 in 0.01 millimeter.

EPITHEMIA ARGUS Ehrenberg var. AMPHICEPHALA Grunow. Plate 5, figs. 7, 8.

Valve arcuate, with capitate ends. Length, 0.0646 millimeter; breadth, 0.0102. Striæ, 3 in 0.01 millimeter.

EPITHEMIA ARGUS var. LONGICORNIS Grunow. Plate 5, fig. 9.

Valve long, linear, with round ends. Length, 0.1275 millimeter; breadth, 0.0136. Striæ, 3 in 0.01 millimeter.

EPITHEMIA TURGIDA (Ehrenberg) Kützing. Plate 5, figs. 10, 11.

Valve arcuate, with ends subcapitate. The raphe curved toward the ventral edge which it closely follows. Length, 0.0816 to 0.1445 millimeter; breadth, 0.00136 to 0.0017. Striæ, 3 to 4 in 0.01 millimeter.

EPITHEMIA TURGIDA (Ehrenberg) Kützing var. VERTAGUS Kützing forma. Plate 5, fig. 12.

Valve linear, lanceolate, with subrostrate ends. Length, 0.170 to 0.212 millimeter; breadth, 0.0153 to 0.0187. Striæ, 5 in 0.01 millimeter.

EPITHEMIA TURGIDA var. WESTERMANNI Kützing. Plate 5, fig. 13.

Valve short. Length, 0.0595 millimeter; breadth, 0.0102. Striæ, 3 in 0.01 millimeter.

EPITHEMIA ZEBRA Ehrenberg. Plate 5, figs. 14 to 16.

Valve elongate with rounded ends. Length, 0.0374 to 0.068 millimeter; breadth, 0.0102 to 0.0119. Striæ, 3 to 4 in 0.01 millimeter.

RHOPALODIA GIBBA (Ehrenberg) O. Müller. Plate 5, fig. 18.

Valve linear, arcuate on the dorsal, straight on the ventral side, reflexed at the extremities. Length, 0.1241 to 0.136 millimeter; breadth, 0.0102 to 0.011. From the side view, 0.0238 to 0.024 millimeter. Striæ, about 7 in 0.01 millimeter.

RHOPALODIA GIBBA var. MAJOR var. nov. Plate 5, fig. 19.

Valve very long. Length, 0.200 to 0.260 millimeter; breadth, 0.0102 to 0.012. Striæ, about 7 in 0.01 millimeter. Zone view, 0.022 to 0.023 millimeter.

RHOPALODIA VENTRICOSA (Grunow) O. Müller. Plate 5, fig. 17.

Valve gibbous in the middle on the dorsal side, straight on the ventral side, with reflexed apices. Length, 0.0425 to 0.0765 millimeter; breadth, 0.0112. Striæ, 7 in 0.01 millimeter.

HANTZSCHIA AMPHIOXYS (Ehrenberg) Grunow var. XEROPHILA Grunow. Plate 5, fig. 20.

Valve slightly arcuate, with rostrate apices. Length, 0.0374 millimeter; breadth, 0.0068. Keel puncta, 7 in 0.01 millimeter. Striæ, transverse, 18 in 0.01 millimeter.

HANTZSCHIA AMPHIOXYS (Kützing) Grunow var. HINGANENSIS var. nov. Plate 5, fig. 21.

Valve slightly arcuate, with rostrate apices. Length, 0.133 to 0.181 millimeter; breadth, 0.0136 to 0.0153. Keel puncta, 4 in 0.01 millimeter. Striæ, 15 in 0.01 millimeter.

CYMATOPLEURA SOLEA Brebisson. Plate 5, fig. 22.

Valve oblong, with subtruncate ends, constricted in the middle. Length, 0.1369 millimeter; breadth, 0.0296. Costæ about ? Striæ ?

CYMATOPLEURA SOLEA var. GRACILIS Grunow. Plate 5, fig. 23.

Valve long, with cuneate ends, constricted in the middle. Length, 0.192 millimeter; breadth, 0.026.

CYMATOPLEURA ELLIPTICA Brebisson var. GENUINA Grunow. Plate 5, fig. 24.

Valve elliptical, with cuneate apices. Length, 0.1406 to 0.185 millimeter; breadth, 0.066 to 0.074.

SURIRELLA ROBUSTA Ehrenberg var. MANSCHURICA var. nov. Plate 5, fig. 25.

Valve linear-ovate. Length, 0.1037 to 0.187 millimeter. Costæ, 2 in 0.01 millimeter. Frustule in zone view clavate.

SURIRELLA LINEARIS W. Smith. Plate 5, fig. 26.

Valve linear, lanceolate. Length, 0.125 millimeter; breadth, 0.0255.

ILLUSTRATIONS

Plate 1

Fig. 1. *Melosira varians* Agarth.
2. *Melosira distans* Kützing.
Figs. 3 and 4. *Melosira italica* Kützing.
Fig. 5. *Melosira italica* var. *genuina* f. *tenuis* (Kützing) O. Müller.
6. *Tabellaria flocculosa* Kützing.
7. *Tabellaria fenestrata* (Lyngb.) Kützing.
8. *Meridion constrictum* Ralfs.
9. *Meridion circulare* Agarth.
Figs. 10 to 15. *Fragilaria hinganensis* sp. nov.
16 and 17. *Fragilaria hinganensis* var. *longissima* var. nov.
Fig. 18. *Synedra ulna* Ehrenberg.
Figs. 19 and 20. *Synedra ulna* Ehrenberg var. *danica* Kützing.
21 and 22. *Synedra ulna* Ehrenberg var. *amphirrhynchus* Ehrenberg.
Fig. 23. *Synedra ulna* Ehrenberg var. *oxyrhynchus* Kützing.
Figs. 24 and 25. *Synedra acus* Kützing var. *delicatissima* W. Smith.
Fig. 26. *Synedra acus* Kützing var. *angustissima* Grunow.

Plate 2

Fig. 1. *Eunotia pectinalis* Kützing var. *ventricosa* Grunow.
2. *Eunotia pectinalis* Kützing var. *impressa* O. Müller.
3. *Eunotia pectinalis* var. *impressa* forma *curta* V. Heurck.
Figs. 4 and 5. *Eunotia lunaris* Ehrenberg.
Fig. 6. *Diploneis puella* (Schum.) Cleve.
7. *Neidium iridis* Ehrenberg.
8. *Neidium iridis* Ehrenberg var. *ampliata* Ehrenberg.
9. *Neidium iridis* Ehrenberg var. *firma* V. Heurck.
10. *Neidium affine* Ehrenberg var. *genuina* Cleve forma *media* Cleve.
11. *Neidium affine* Ehrenberg var. *amphirhynchus* Ehrenberg forma *manschurica* forma nova.
12. *Frustulia vulgaris* Thw. var. *asiatica* var. nov.
13. *Navicula bacilliformis* Grunow.
14. *Navicula radiosa* Kützing var. *manschurica* var. nov.
15. *Navicula peregrina* Ehrenberg.
16. *Navicula reinhardii* Grunow.
17. *Navicula cincta* Ehrenberg var. *leptocephala* Ehrenberg.
18. *Navicula* sp.
19. *Navicula amphibola* Cleve var. *manschurica* var. nov.
20. *Pinnularia mesolepta* Ehrenberg var. *stauroneiformis* Grunow.
21. *Pinnularia brebissoni* Kützing var. *diminuta* V. Heurck.
22. *Pinnularia nodosa* Ehrenberg.
23. *Pinnularia legumen* Ehrenberg.

FIG. 24. *Pleurostauron acuta* W. Smith.
25. *Stauroneis phoenicenteron* Ehrenberg var. *genuina* Cleve forma.
26. *Stauroneis phoenicenteron* Ehrenberg var. *genuina* Cleve.
27. *Stauroneis phoenicenteron* Ehrenberg var. *amphilepta* Ehrenberg.
28. *Stauroneis phoenicenteron* Ehrenberg var. *vulgaris* Dippel forma *intermedia* Dippel.
29. *Gomphonema acuminatum* Ehrenberg var. *coronata* Ehrenberg.

FIGS. 30 and 31. *Gomphonema acuminatum* Ehrenberg var. *brebissonii* Kützing.

FIG. 32. *Gomphonema acuminatum* Ehrenberg var. *trigonocephala* Ehrenberg.

PLATE 3

FIGS. 1 and 2. *Pinnularia episcopalis* Cleve var. *manschurica* var. nov.

FIG. 3. *Pinnularia major* Kützing.
4. *Pinnularia major* Kützing forma *manschurica* forma nova.
5. *Pinnularia viridis* Nitzsch.
6. *Pinnularia viridis* Nitzsch var. *intermedia* Cleve.
7. *Pinnularia nobilis* Ehrenberg var. *intermedia* Dippel.
8. *Pinnularia nobilis* Ehrenberg var. *manschurica* var. nov.
9. *Gomphonema parvulum* Kützing var. *micropus* Kützing.
10. *Gomphonema constrictum* Ehrenberg var. *capitata* Ehrenberg.
11. *Gomphonema constrictum* Ehrenberg forma *curta* Grunow.
12. *Gomphonema sphaerophorum* Ehrenberg.

FIGS. 13 and 14. *Gomphonema geminatum* Lyngb.

FIG. 15. *Cymbella cuspidata* Kützing.

FIGS. 16 to 18. *Cymbella ventricosa* Kützing.

FIG. 19. *Amphora ovalis* Kützing var. *libyca* Ehrenberg.
20. *Cymbella cuspidata* Kützing.

PLATE 4

FIGS. 1 and 2. *Cymbella aspera* Ehrenberg.

FIG. 4. *Cymbella aspera* Ehrenberg var. *elongata* var. nov.
5. *Cymbella aspera* Ehrenberg var. *manschurica* var. nov.

PLATE 5

FIG. 1. *Cymbella heteropleura* Ehrenberg.
2. *Cymbella tumida* Brebisson var. *borealis* Grunow.
3. *Cymbella cistula* Hempr.
4. *Cymbella cistula* Hempr. var. *manschurica* var. nov.
5. *Cymbella cistula* Hempr. var. *hinganensis* var. nov.
6. *Epithemia sorex* Kützing.

FIGS. 7 and 8. *Epithemia argus* Ehrenberg var. *amphicephala* Grunow.

FIG. 9. *Epithemia argus* Ehrenberg var. *longicornis* Grunow.

FIGS. 10 and 11. *Epithemia turgida* (Ehrenberg) Kützing.

FIG. 12. *Epithemia turgida* (Ehrenberg) Kützing var. *vertagus* Kützing forma.
13. *Epithemia turgida* (Ehrenberg) Kützing var. *westermanni* Kützing.

FIGS. 14 to 16. *Epithemia zebra* Ehrenberg.

FIG. 17. *Rhopalodia ventricosa* (Grunow) O. Müller.
18. *Rhopalodia gibba* (Ehrenberg) O. Müller.
19. *Rhopalodia gibba* (Ehrenberg) O. Müller var. *major* var. nov.
20. *Hantzschia amphioxys* (Ehrenberg) Grunow var. *xerophila* Grunow.
21. *Hantzschia amphioxys* (Kützing) Grunow var. *hinganensis* var. nov.
22. *Cymatopleura solea* Brebisson.
23. *Cymatopleura solea* Brebisson var. *gracilis* Grunow.
24. *Cymatopleura elliptica* Brebisson var. *genuina* Grunow.
25. *Surirella robusta* Ehrenberg var. *manschurica* var. nov.
26. *Surirella linearis* W. Smith.

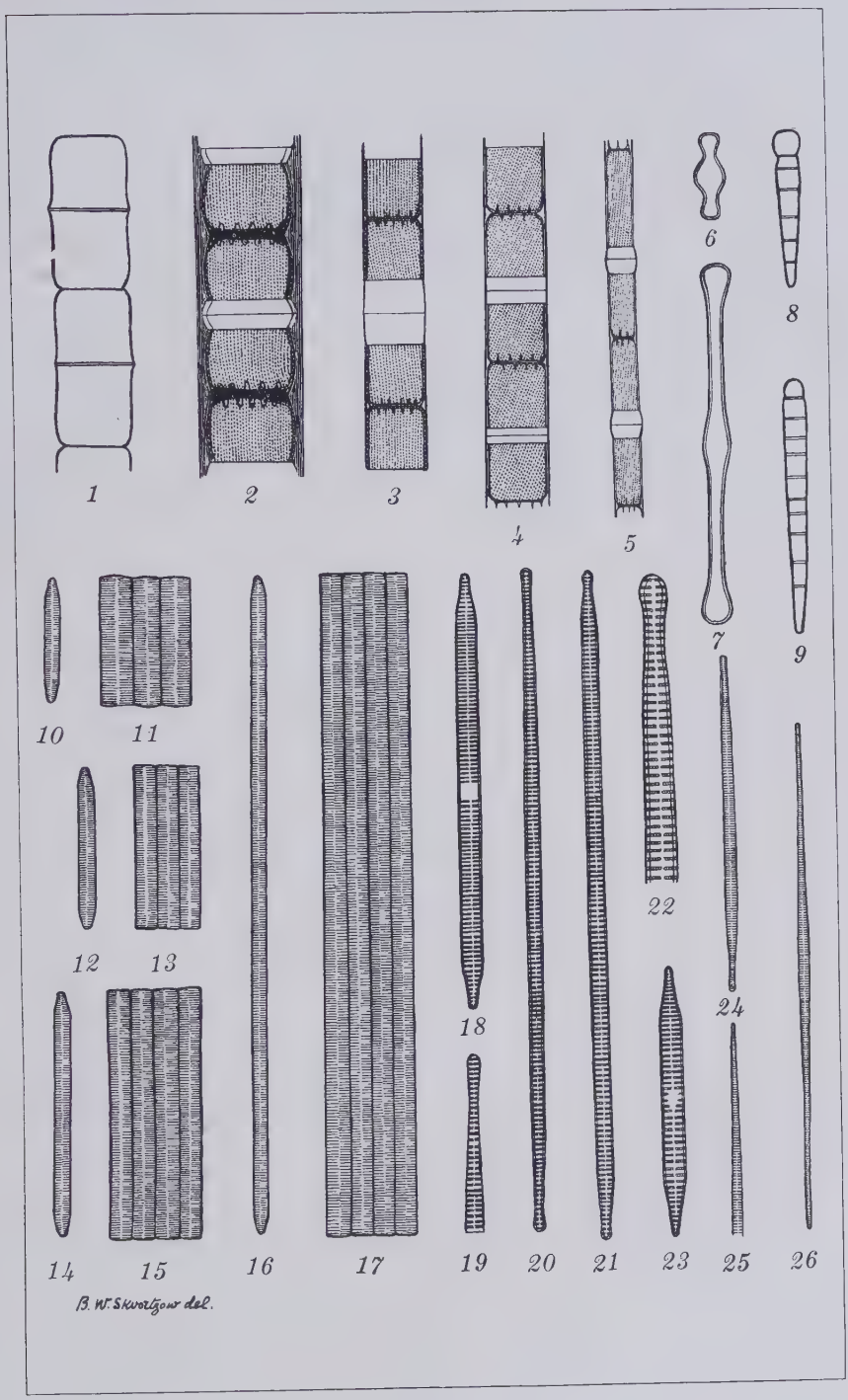
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PLATE 1.

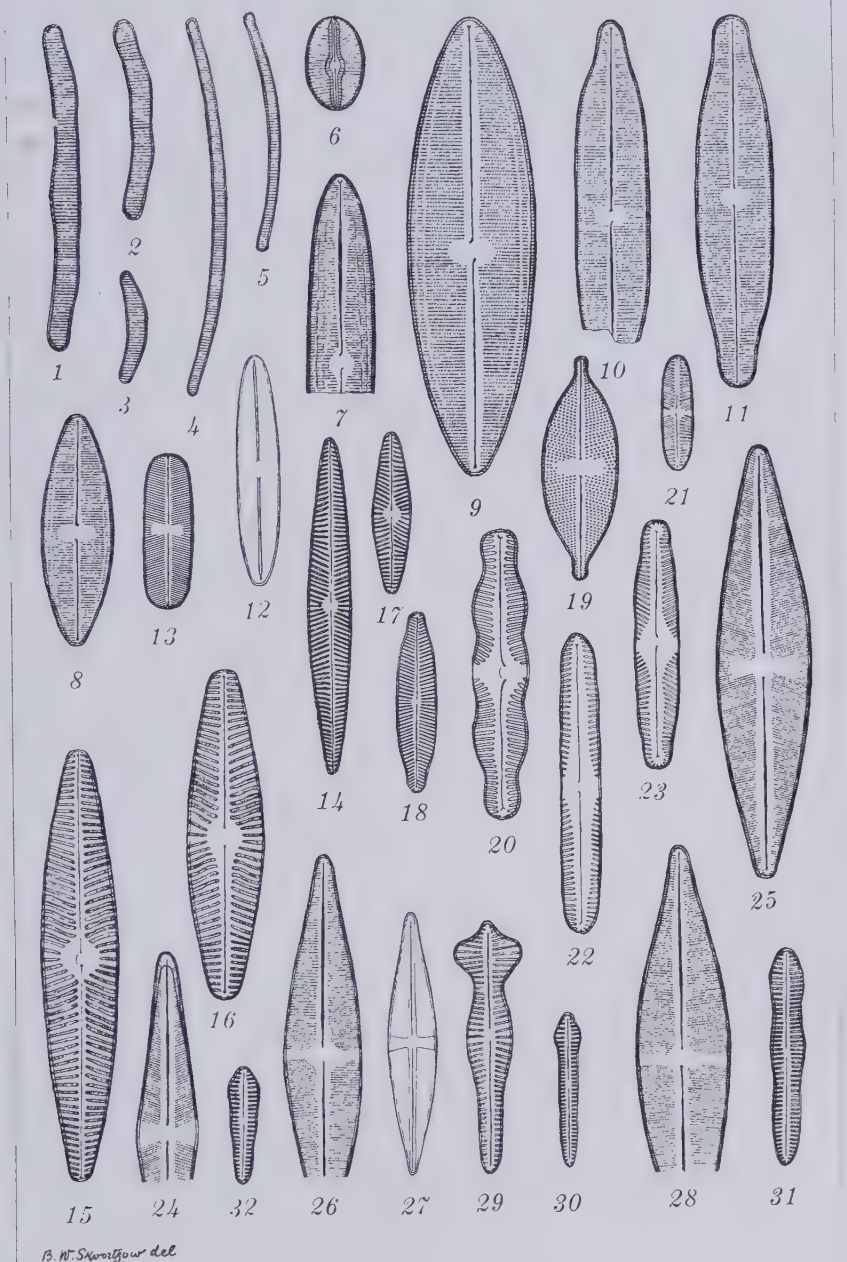
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PLATE 2.

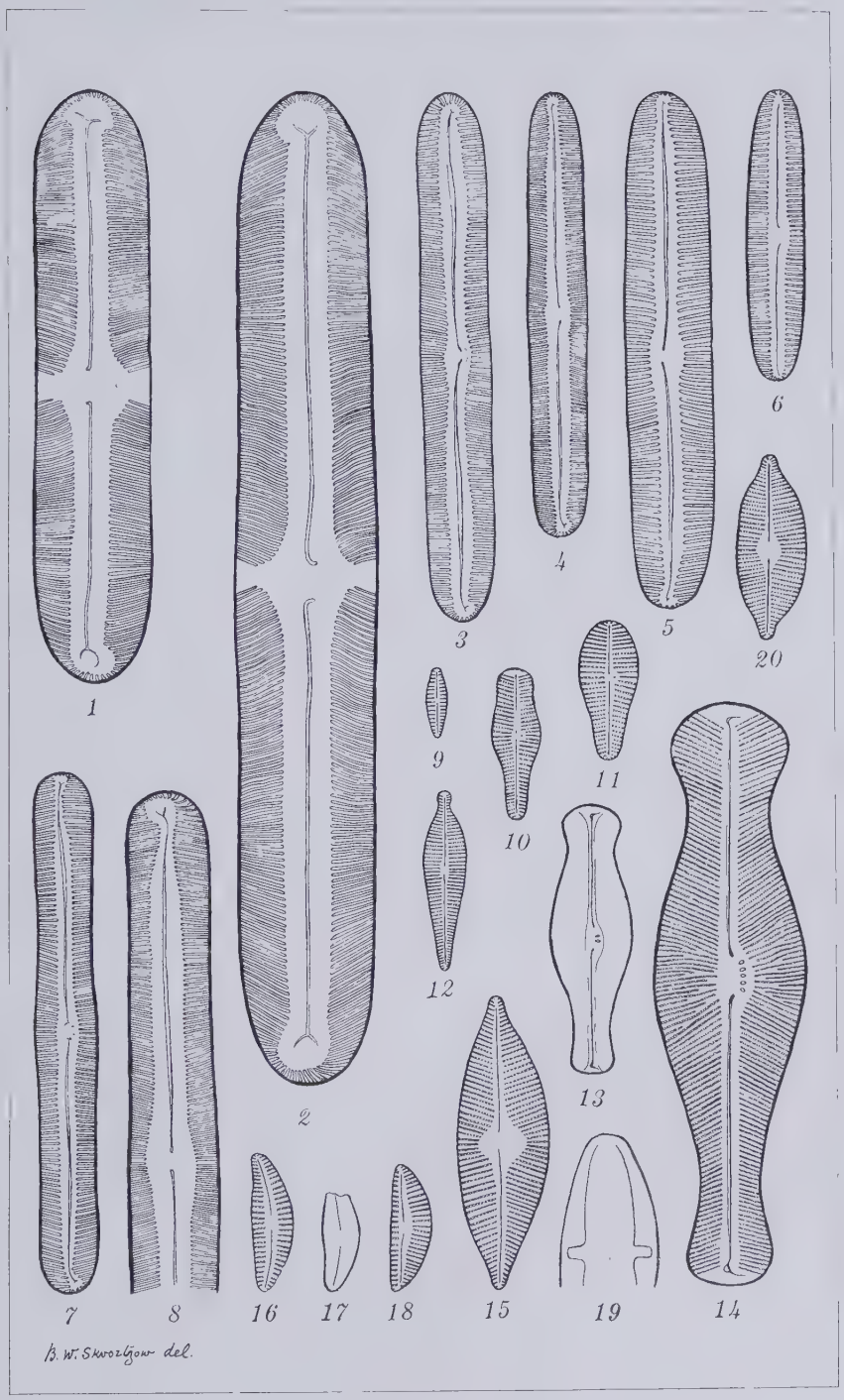

PLATE 3.

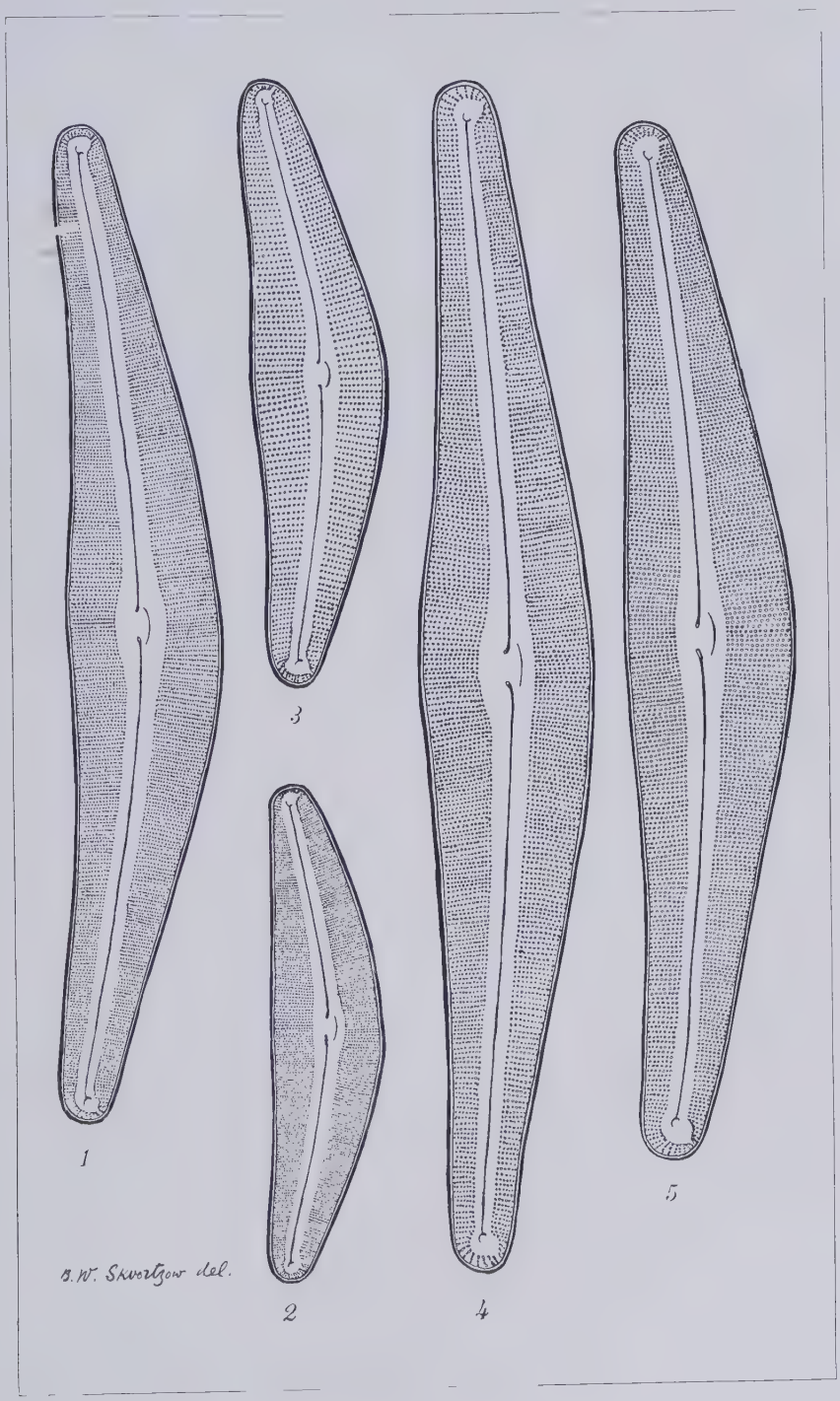

PLATE 4.

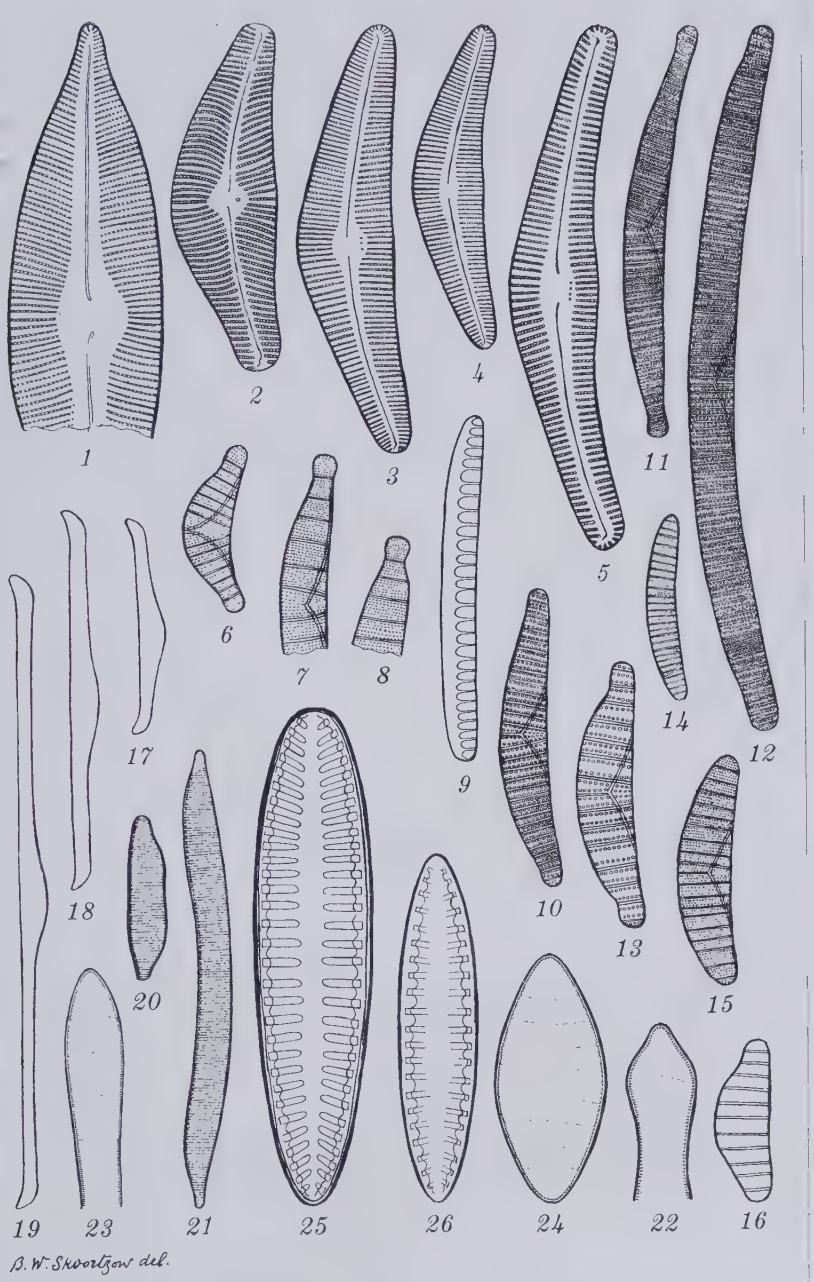
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PLATE 5.

THE NATURAL HISTORY OF A PHILIPPINE NIPA HOUSE WITH DESCRIPTIONS OF NEW WASPS

By Francis X. Williams

Of the Experiment Station, Hawaiian Sugar Planters' Association, Honolulu

EIGHT PLATES

During a residence of more than two and a half years in the Philippine Islands, while engaged by the Experiment Station of the Hawaiian Sugar Planters' Association in entomological work, I was so deeply impressed by the abundance, diversity, and interest of the little creatures that shared my dwelling that I decided they should go on record. The observations that follow were made chiefly on the northern island Luzon, with supplementary notes from Mindoro, Panay, Cebu, Negros, and Mindanao. The College of Agriculture, at Los Baños, Luzon, was my home for the greater part of the time, and because of its situation, at the base of Mount Maquiling, extremely rich in plant and animal life, no better place for this study could have presented itself, for not only do the habitués of man's domicile flourish there, but many denizens of the forest make it their abode.

The building, to receive the full benefit of such occupancy, must be an open nipa house (Plate 1, fig. 1), preferably of some antiquity. No doubt the modernized screened-in structures with ceilings and tight wooden floors are more durable and in some ways excel in comfort, but they exclude such interesting household pets as the larger lizards, the banana frog, and the several bats, as well as the greater bulk of winged insects that are attracted to lights.

The nipa house is usually constructed of four kinds of material; namely, timber, bamboo, rattan, and nipa. For the foundation of the better type of house carefully selected limbs or tree trunks of the durable sort are employed. These *arigues*,[1]

[1] *Haligue* or *haligi* (Tagalog) from which *harigue* or *arigue* (Spanish), usually the trunk of a tree from which the bark and branches have been removed, used as one of the supports of a house; a pillar or column of any material and shape.—Editors.

or main posts, support the house proper several feet off the ground, and if they are cracked, their splicing imperfect, or the wood liable to attacks of insects, to that extent is the natural history of the domicile enriched. Sawn lumber is much used for flooring. Bamboo, the giant among grasses, grows in huge clumps that rattle and creak weirdly in the breeze, and *Bambusa blumeana* Schultes is the most important element in house building. As poles it forms the grosser framework of the sides and of the roof (Plate 1, fig. 2) and, when split into slender laths, the more delicate structure there, as well as the flooring; and finally, it is woven as thin strips to make *sawale*, which in single or double sheets is used for wall material and to cover the sliding door and window frames. It is obvious that bamboo poles, particularly if cracked open or perforated, furnish excellent retreats for the more retiring creatures, whereas the double wall often harbors animals and nests of surprising bulk. Rattan, or *bejuco* (*Calamus*), is a slender climbing palm the younger parts of which are armed with annoying spines. Its stem is exceedingly strong and, when split into flexible strips, substitutes in great measure for nails, being used in securing the shingles to the bamboo framework and for other light work. The loose end of a bejuco cord hanging under the roof is often used as a nesting site by at least one species of wasp. The nipa palm (*Nipa fruticans* Wurmb) grows along tidal streams throughout the Philippines and is a very useful plant. It is rich in sugar, the sap furnishes an intoxicating drink, and the leaves are cut, folded, and fastened to form shingles, the roof covering for the majority of Filipino houses. Much animal life may lurk in such thatching. A bamboo net properly overlies the entire roof and protects it from the effects of heavy winds.

For our purpose it is necessary to consider the furniture, and even such embellishments as potted plants, in relation to the house fauna. Proximity to the forest, as exists on the slopes of Mount Maquiling, as well as to cultivated garden plants, helps diversify this fauna.

Included in this obviously very imperfect survey of the animal life of a nipa house, are the animals that make it their permanent home, the regular patrons, occasional visitors, and some of the creatures that work, recreate, or rest in the shelter of such a building.

Mention must be made of some of the important accessories of the more-typical country-side dwellings; of the useful though

ill-smelling carabao, or water buffalo, indispensable in the culture of rice, the staple food in the Islands; of the hard-working Philippine pony; of the specimens of the porcine world with their saddle backs; of the dogs and the cats; and of the domestic fowls that may roam where they will. The Philippine gamecock is an asset or a liability, as the case may be, to the roof that shelters it.

An interesting account of insects found in and about houses in India is given by Stebbing.[2]

Much has been omitted from the fauna of the Philippine nipa house, and it will become evident that I have favored some groups over others, placing undue emphasis, perhaps, on certain forms of life that seldom occur in houses but belong more properly to the forest. Enough has been written, however, to give the reader a general idea of what animal life may be found in houses of the type described.

Thanks are here extended to all of those who have assisted me in this work, chiefly to officers of the United States National Museum, for identifying various insects; to Dr. Wm. M. Wheeler, for determining most of the ants; to Prof. T. D. A. Cockerell, for determining certain of the bees; to Mr. Nathan Banks, for determining Neuroptera and Corrodentia; to Prof. S. F. Light, for determining the termites; and to the late Prof. C. F. Baker, dean of the College of Agriculture, Los Baños, Philippines, for determinations, material, and for other assistance.

INVERTEBRATES

SCORPIONOIDEA

The scorpion, a much-modified relative of the spider, has no antennæ, and the head and thorax are inseparably fused; on the other hand, it lacks a waist, is armed with a pair of strong pincers, and the venom resides not at the base of the chelæ or fangs,[3] but in a poison sac and sting that terminate the slender part of the abdomen, which can be elevated and brought forward

[2] Insect Intruders in Indian Homes. Thacker, Spink & Co., Calcutta. 1–154; many illustrations.

[3] In pseudoscorpions, which also are Arachnida much resembling a very diminutive scorpion, lacking the tail, and familiar to many of us as occurring under bark, among old papers (book scorpions), and also clinging by means of their strong pincers or chelæ to insects, Chamberlain, Ent. News. 35 (1924) 205–209, fig., has shown that for some groups a well-developed poison apparatus, residing in two or in all the fingers of the pedipalpi and opening near their tip, is present.

over the well-segmented body. Scorpions are solitary and nocturnal and attain their greatest development in warm countries. They do not lay eggs, and the newly born young cling to the body of the mother and are thus carried about for some time. They are considered long-lived creatures; and Fabre, who studied a species in the south of France, concluded that it took them several years to reach maturity. They range in size from about 15 millimeters to more than ten times that length. The west African *Pandinus imperator* attains a length of 20 centimeters, and the Indian *Palamnaeus swammerdami* (Simon) scarcely less.

Very large scorpions also occur in the southern Philippines and on islands to the south, but the house inmates treated here are not such monsters; *Hormurus australasiae* Fabricius, Ischnuridæ (*ischnurus*, slender tail), is the only one I have found guilty of this domiciliary habit about Los Baños. Large specimens of this species are 45 millimeters, or about 1.75 inches, in length. The forceps are large and stout, and the tail, though slender, is comparatively short. One specimen was found on the floor by my bed, probably having been dislodged from the nipa roof far overhead; another secreted itself between sheets of some coarse botany paper; but probably a more natural habitat was the base of the leaves of certain palms almost touching the house. Here a female scorpion was seen with her family of fourteen young clinging to her legs and the sides of her body, not by their pincers but by means of their regular legs.

ARACHNIDA

SPIDERS

Only a few of the many species of house-loving spiders can be considered here. Some of the Indian kinds are of very large size, for Pocock [4] speaks of the genus *Poecilotheria* (Theraphosidæ), members of which have a body length exceeding 5 centimeters, as dwelling in trees or in the thatch of houses. Undoubtedly, the most widely known of all tropical house spiders is *Heteropoda regia* Fabricius, Clubionidæ (Plate 8, fig. 5), a long-limbed, swift creature of flattish posture with a body about 2.5 centimeters in length, that has been artificially introduced from the Orient into all tropical countries. It is known by several names; for example, the Nancy spider, in British Guiana; it is also called the huntsman; and, because of its powers of

[4] Fauna Brit. Ind., Arachnida (1900) 188.

progressing sideways (laterigrade), and perhaps also by reason of its pose, the crab spider. To many a newcomer this active creature, stretched out to intimidating dimensions on the wall, seems an objectionable roommate, but it is harmless and very beneficial in habits. *Heteropoda* comes under the category of hunting spiders, for it spins no snare but catches its prey by rushing upon it. It inhabits a variety of places, patronizing the hollows of trees, living among banana plants, and in the Hawaiian Islands is an object commonly observed in houses, while out of doors it may pass the day squeezed among the leaf bases of the larger plants of the sugar cane. The gauntness and sluggishness of individuals in houses often indicate that they do not always fare well indoors. The female encases her eggs, to the number of several hundred, in a large, flat button-like cocoon which she carries about between her legs, holding it in position with her leglike feelers (pedipalps) and her fangs. Ehrhorn [5] and Pemberton [6] found that about thirty-five days were required for hatching, and during all this time Pemberton's spider took no food but broke her fast on a cockroach immediately upon giving birth to her children. The spider is useful in the house, because it feeds on cockroaches. It comes out of its retreat at night and is often found on the floor. At Los Baños I have seen it eating a young *Scolopendra* centipede, a moth, and a long-horned grasshopper. It also feeds upon house ants of the genus *Camponotus*. Insects that fly to light also attract it. Wherever it travels it liberates a silken guide thread from its spinnerets.

Another laterigrade spider of even greater swiftness than *Heteropoda* is a far less-common and smaller species belonging to the genus *Hersilia* (Hersiliidæ). It is characterized among other ways by the comparatively short third pair of legs and by the excessively long spinnerets—a pair of jointed appendages which extend close together far beyond the end of the body. It is more of an outdoor spider, living in protective coloration on tree trunks, and occasionally is to be found in a head-downward, spread-out, and flattened posture on a porch post, occupying the same spot for weeks at a time. At first no web, apart perhaps from its silken bed, is evident; but closer inspection shows that each of the longer legs rests on a strong thread, the threads collectively radiating from her as a center, the strands

[5] Proc. Haw. Ent. Soc. 2 (1912) 196.
[6] Proc. Haw. Ent. Soc. 3 (1917) 273.

keeping close to the curvature of the post and joining outwardly to form a somewhat oblong rosette (Plate 4). Presumably, any small creature stepping on one of these threads would notify the proprietor thereby and a meal for the spider might result. It is an exceedingly swift spider that literally shoots around to the other side of the tree or post when disturbed.

Among the Attidæ (Salticidæ) are several species that may frequent houses. This very extensive family contains the familiar, thickset, little jumping spiders, sharp-sighted and sun-loving, that creep up to their prey and pounce upon it with surprising accuracy. They are often brightly colored and sometimes of rather striking from, particularly those resembling ants, with which they may then associate. They form no web except a sort of tubiform retreat in which to lay eggs, cast their skins and, in temperate countries, to pass the winter.

I shall now touch briefly upon a few of the sedentary kinds of spiders, that spin webs in which to ensnare their prey. Some of these, because of their habit of living in or near buildings, easily lend themselves to transportation and thus have spread to many countries. Foremost in size and striking appearance, though far less domiciliary than some others, are members of the genus *Nephila* (Plate 7, fig. 2) (Argiopidæ) that have representatives throughout the Tropics. Here exists an immense disparity in size between the two sexes for, while a female may be 5 centimeters in length of body and 12 to 15 in spread of legs, the male is probably not the hundredth part of her bulk. They are prettily marked in silvery yellows, reds, and blacks, but what chiefly brings them to notice is the very large, strong, and sticky, as well as annoyingly situated orb web they spin. These webs, which may be several feet in diameter, are made of smooth inelastic silk and some very strong, sticky, yellow threads, and have been known successfully to entangle small birds.

Nephila maculata Fabricius is a common oriental species that occasionally spins her orb on or near porches at the College of Agriculture, Los Baños. The comparatively small reddish male often rests near the outer edge of the great web which is not quite vertical, and in the center of the underhanging side of which the big female stays. Other smaller spiders, polished reddish ones to the number of a dozen or more, some with the abdomen markedly humped, may share her web, spinning in it delicate threads of their own to suit their needs, and feeding

upon insects entangled in the communal net. *Nephila* usually lives along wooded paths or about trees and bushes where a large variety of insect prey is available; those making their orbs about house porches perhaps do not thrive so well. The prey is often enshrouded in silk and then sucked of its juices, and the remnants, like any foreign material, cut out of the web and dropped. The large *Ornithoptera* butterflies sometimes fall victims to these spiders, and I once saw the big malodorous pentatomid bug *Tesseratoma longicornis* being eaten by one of these spiders that had spun on the porch. This victim was not yet dead and its odor was noticeable from a distance of a foot or more away; soon the arachnid, as though the flavor were too much for her, ceased biting into her prey, wrapped it up a little, bit off all of its sustaining threads but one, made this one more secure, and then commenced cleaning the terminal joints of her legs that had probably been affected by the bug's odor. Nevertheless, she later continued her meal upon this pungent morsel and was not done with it until the following day. At first, hovering toward dusk in a little swarm about the carcass, but eventually feeding in company with the spider, were a number of little fly midges, their heads in at the unoccupied wounds made by her. These spiders envelop their eggs in a silken cocoon. The habits of the giant wood spider (*Nephila maculata*) are treated at length by Hingston in India.[7]

The tetragnathous spiders (Argiopidæ) are most easily recognized by their long projecting cheliceræ, or mandibles, and elongate bodies and legs which, when at rest, are stretched out fore and aft. Two or three species were observed with their orbs fastened to the tips (leaflets) of the nipa shingles that projected over the eaves. The spiders remain concealed during the day, inconspicuously stretched out along the underside of the extremity of a palm shingle, but toward dusk much life is evident in this leaf fringe thrown out against the fading sky; nets are made over or repaired, the body being twisted awkwardly during this operation; then the artisans, assuming a more relaxed posture in the orbs, await their prey. These orbs are slightly off vertical and one measured 30 centimeters wide by 8 centimeters high; size and configuration are probably governed to a great extent by the points of attachment available. Little flies, caddis flies, and winged termites constitute a good

[7] Journ. Bombay Nat. Hist. Soc. 28 (1923) 642 et seq., 4 parts.

part of their food. The tetragnathous spiders are very active orb weavers and many of them show a predilection for spinning over or near water. Some species have a very wide distribution and in the Hawaiian sugar-cane fields one or more kinds were often conspicuous during the bad leaf-hopper years and fed mainly upon this pest.

The family Pholicidæ is made up of very long-legged spiders represented in Philippine houses by at least two species. One of these hangs in its webs in some corner, and when disturbed shakes rapidly up and down with the structure. In aspect and coloration they strongly resemble certain "daddy longlegs" (tipulid flies) in the Philippines, which hang by their anterior legs to a horizontal spider thread and swing in unison.

Usually extending from beam to beam on the underside of the bamboo lath flooring are numerous, unsightly spider webs that catch the floor sweepings of dust, termite wings, etc., the snares of what appears to be *Artema atlanta*, the dominant spider under the floor. They crouch upside down in these thin webs that are domed in the center or to one side. An interesting account of common Indian spiders is given by Gravely.[8]

CHILOPODA and DIPLOPODA

CENTIPEDES AND MILLIPEDES

No matter how well ordered the nipa house, it is sure to harbor some of these elongate arthropods. Centipedes (Chilopoda) are usually provided with a single pair of legs to each segment, the first pair, however, being modified as poison claws with which the animals defend themselves or seize and subdue their prey. They are as a rule very swift of movement, particularly the forms that are not overburdened with an extreme length of body or multiplicity of ambulatory appendages. Millipedes (Diplopoda) have most of the segments equipped with two pairs of legs, and are generally inoffensive to man. Their movements are usually much slower than those of the centipedes, and they seek protection when attacked, mainly by curling up into a spiral and by exuding a strong fluid that is often capable of burning the skin. Centipedes are mainly predaceous. Millipedes, on the other hand, commonly eat plant food or act as scavengers in organic material.

[8] Journ. Bombay Nat. Hist. Soc. 28 (1923) 1045–1050, 5 pls.

About Los Baños perhaps the most frequently observed centipede in houses is a very slender, many-legged one abundant in the leaf thatching and also to be found crawling along the floor or other woodwork. Its means of defense—as when roughly handled, or wounded—consists in exuding a luminous substance of distinctive odor from the sides of its body and thereby producing a greenish yellow light in the darkness. However, this centipede, small and slender, is harmless to man, but probably large species, of the well-known genus *Scolopendra,* that often frequent houses in the Tropics, are capable of causing great pain. Nevertheless, they must be regarded as generally beneficial, since they wander about at night in search of cockroaches, beetles, and other vermin. Occasionally, a more-venturesome one will attack very large quarry, as can be seen from the following quotation: [9]

> I was disturbed one night by the noise of a sparrow in distress, and thinking that a snake had probably got hold of it, I pulled down the nest which was in the roof of my verandah, and found a large centipede clinging round the sparrow's body with its head buried in the bird's side. The centipede would not or could not let go its hold, and was cut away with a pair of scissors.
>
> The sparrow had a hole in its side about half an inch in width and the same in depth, and was quite dead and fell to the ground when I pulled the nest down.

Millipedes are more rarely encountered in nipa houses. At Los Baños an ordinary-looking, cylindrical species occasionally crawls up into a stilted house and one such arthropod or, rather, half of one was seen to fall from the ceiling; the inference is that a house lizard had cut it in two.

ORTHOPTERA

BLATTIDÆ

COCKROACHES

Several species of cockroaches inhabit houses, and some of these are of cosmopolitan distribution. No list of Philippine species was made, but one is sure to find the large brown *Periplaneta americana* (Linnæus), and *Blatella germanica* (Linnæus), the Croton bug, among those present in nipa houses. *Periplaneta australasiae* (Fabricius), much like an undersized

[9] Cumming, W. D., Journ. Bombay Nat. Hist. Soc. 15 (1903–1904) 364, 365. Ormara, Persian Gulf, July, 1903.

P. americana, is common at Los Baños and, if something appetizing was placed in the waste-paper basket in my room and at night a flash of light directed on this paper-lined receptacle, it startled the cockroaches, great and small, and they dispersed noisily. What appears to be *Lupparia adimonialis* Walker and a species of a genus rather close to *Lupparia* have also been taken indoors at Los Baños.

Most roaches of more or less domiciliary habit are nocturnal and fond of hiding during the day in dark places; there is one species (*Holocompsa debilis* Walker) that is often seen in the daytime in and on houses, but scarcely addicted, I believe, to frequenting the kitchen. This little species is between 4 and 5 millimeters long and moves about in sprightly, jerking fashion, and strongly suggests a small, thickset bug. It appears native to the East Indies.

ISOPTERA

TERMITES, OR WHITE ANTS

No list of tropical house fauna would be complete that did not include termites, those insidious social insects that fly to our lights in rustling swarms and pursue their hidden work of destruction within our house timbers and furniture. The study of these most interesting pests is fraught with difficulty, as an unsatisfactory classification shows, while their biology is of a secretive and often very complex nature and presents many problems to the student. Their colonies are frequently composed of immense numbers of individuals and this fact, coupled with subterranean or internal habitats, renders them foes especially difficult to cope with.

Despite their destructive habits, termites play a useful part in nature; to quote Imms [10]—

> The role of subterranean termites has been compared by Drummond ("Tropical Africa") with that of earthworms. By means of their underground activities they keep the soil in constant circulation, rendering it permeable to air and moisture. Also the faecal matter of these insects serves to enrich the soil that is free from the burrows of these insects, and the number of individuals of the latter present defies all calculation.

Termites assist in the disintegration of dead timber. In some tropical countries the material from termite mounds is gathered and pounded down to make a very serviceable ground flooring for outhouses, tennis courts, etc.

[10] A General Textbook of Entomology (1924) 266.

The Philippines has a wealth of Termitidæ, or *anay*, as they are called in the Tagalog dialect, and, while but thirty-nine species appear to have been listed and described from there,[11] many new ones will undoubtedly be found in the Islands.[12] Considerable work has been done on the life history and classification of termites, and a very good general idea of these insects is given by Wheeler [13] and by T. E. Snyder.[14] As many as eight castes exist among the Termitidæ and, as these are represented by both sexes, there can be sixteen different kinds of individuals.[15] There may be three forms of functional males and females, the first of which is familiar to us as the flying specimens, and it is the female or queen of this form, when successful in starting a colony with her mate, that may develop an abdomen so large as somewhat to suggest a potato and renders her quite helpless to feed herself or to take a stroll. In fact, because of her increasing size, she is a prisoner within the royal chamber. Such a queen lives for years and lays an enormous number of eggs and is capable of producing all the castes peculiar to the species. The other two castes of functional females are flightless and usually of smaller size and less chitinized, and are not able to produce forms above their rank. The soldiers and the workers are sterile, but modified otherwise, as their names imply; the workers usually form the great bulk of the nest population. The soldiers have the head remarkably developed as to size, shape, chitinization, and function; many have powerful nipping jaws, others the power to eject a milky or a clear, repellent liquid through the front of the head, which is sometimes greatly produced as a snout. These soldiers, male and female, are true protectors, and frequently act as scouts and guard the line of march. As a rule, only the functional males and females have compound eyes.

Many kinds of termites make nests wholly or in part above ground, as mounds or carton nests; these are composed to a large extent of excreta and masticated soil and wood materials. There are, as in certain ants (*Atta*, etc.), termites that cul-

[11] Light, S. F., Notes on Philippine termites, Philip. Journ. Sci. 18 (1921) 234–257; 19 (1921) 23–64, 6 pls. and 3 text figs.

[12] About 1,500 species of termites have been described for the world, Cleveland, Quart. Rev. Biol. 1 (January, 1926).

[13] Social Life Among the Insects. New York, Harcourt, Brace and Co. (1923) 1–375, illus.

[14] Biology of the termite castes, Quart. Rev. Biol. 1 (October, 1926).

[15] Wheeler, op. cit.

tivate fungus in subterranean gardens, as illustrated in a common large Philippine mound builder, *Macrotermes gilvus* Hagen;[16] others are not thus agriculturally inclined, although a few collect grass, lichens, etc.; most of them, however, with the aid of an intestinal fauna of Protozoa, eat raw or decaying wood. Cleveland [17] has found that in three of the four families of termites, namely, Mastotermitidæ, Kalotermitidæ, and Rhinotermitidæ, there is a large quantity of intestinal Protozoa; he says, "the protozoa in these insects weigh almost as much as the insects themselves." He goes on to say that most species of the fourth family, the Termitidæ, that had been examined had no Protozoa and that some of these lacking Protozoa have been shown to cultivate fungi which they eat "along with soil, cellulose and hemicellulose which the fungus has acted upon." Here each outgoing queen carries away a bit of fungus for a new colony.

Certain species, as, for instance, the Hawaiian *Coptotermes intrudens*, damage buildings, etc., both above and below ground, but these must nest in the soil (soil-nesting termites), while *Cryptotermes piceatus* of the same locality has been termed the dry-wood-inhabiting termite, from its custom of living in and damaging wood above ground.[18] When in quantity some termites, if under dry leaves, etc., are capable of producing a sound comparable to grains of sand falling upon paper; this is done, I believe, by striking the head briskly against the débris.

Termites have many enemies, among them various anteaters (mammals); such birds as swallows and swifts, which secure them in quantity in their late afternoon flights; and lizards and numerous insects. Of the latter ants are probably the most formidable; larger carnivorous species, particularly of the subfamily Ponerinæ, carry the termites off bodily where they are exposed to their attacks; the smaller ants invade their burrows and drive them back. On the whole, however, the termites are so well organized and so prolific that they usually more than hold their own. There appear to be no insect parasites that destroy them wholesale, and the illustration (Plate 5, fig. 1)

[16] See L. B. Uichanco, Philip. Journ. Sci. 15 (1919) 59–66, 4 pls., for descriptions and illustrations of *Macrotermes* fungus gardens in the Philippines.

[17] Quart. Rev. Biol. 1 (January, 1926) 53.

[18] See Muir and Swezey and Fullaway, Haw. Planters' Rec. 30 (July, 1926); and Fullaway, in Haw. For. & Agr. (July–September, 1926).

of a worker of what is probably *Microcerotermes los-bañosensis* Oshima with an exoparasite, or guest larva, clinging to its throat shows something not often seen; the affected termite, taken from a carton nest, did not appear handicapped by its burden which, presently dropping off, revealed a beetle (?) larva with a small head and three pairs of short legs, its general appearance recalling that of a rather smooth, glassy white lady-beetle larva. Termites have a diversity of guests inside their nests and also suffer from worm parasites within their bodies.

CRYPTOTERMES CYNOCEPHALUS Light.

Of this species Light [19] says: "House termites, living in the dry, seasoned wood of planks and boards of houses, in furniture, in picture frames, etc."

CRYPTOTERMES (PLANOCRYPTOTERMES) NOCENS Light.

This has much the same habits as the preceeding. It is common at Los Baños, in wooden houses, and Light (1921, p. 47) believes it is the commonest house termite in Manila.

COPTOTERMES VASTATOR Light, MS.

This is held by Light to be the most injurious Philippine termite. At Los Baños it makes firm, rather narrow runways on houses, etc., from the ground.

MACROTERMES GILVUS Hagen.

The winged form of this large termite expands nearly 5 centimeters. The species is a common mound builder but also attacks house wood on the ground and "makes earthen runways over trees and shrubs, eating their bark."

NASUTITERMES LUZONICUS (Oshima).

This species is injurious to various trees and to "wooden parts of houses." It makes carton nests on tree trunks. The soldiers have long-beaked heads. A common species.

MICROCEROTERMES LOS-BAÑOSENIS Oshima.

Light (1921, p. 254) says: "One of our commonest Philippine termites. Makes hard nests at base of bamboo, cocos, *Pithecolobium*, etc., and builds tunnels over them. Occasionally attacks houses and furniture." A nest of this species, found on the lower slopes of Mount Maquiling, was over 30 centimeters in diameter, resting on the ground or somewhat embedded in it. It was made of stiff, strong, cartonlike material and was finely

[19] Philip. Journ. Sci. 19 (1921) 40.

labyrinthal in character. No true queen was found, although at least a dozen complementary ones, of the second order, with fat bodies, chitinized sclerites, and wing pads, were present. This species is occasionally rather injurious in sugar-cane fields; as it hollows out the living stems of the plant sometimes for 30 centimeters or more above ground. The soldiers have long and effective mandibles.

THE "DAY FORAGER" HOSPITALITERMES SARAIENSIS OSHIMA

A ribbonlike stream of polished brown insects is moving steadily down one of the arigues; it continues its course along the ground and finally pours into a hole at the base of a hollow tree. This early morning scene is enacted by *Hospitalitermes saraiensis*, a "white ant," and perhaps the only Philippine species of the genus that probably owes its dark skin to a rather exposed manner of living, a habit that sets it quite apart from its more-injurious relatives. It is typically a woodland insect, whose orderly columns are often seen crossing some forest trail, and only where there is a considerable extent of shade and trees do we find it in the neighborhood of houses. Such a favorable habitation was the old forestry building perched well up on the slopes of Mount Maquiling. *Hospitalitermes* is frequently spoken of as diurnal; this is not altogether correct, for the truth of the matter is that the colony has so much outdoor work to do that the entire night and a good part of the day are required to accomplish it.

It is quite worth while to devote a little study to these remarkable termites; their life above ground is fairly easy to observe and is what must chiefly concern us. Their hours of toil in the open are naturally somewhat irregular, but a late afternoon or early evening will generally find their dark shining forms massed about the entrance of the burrow, preparatory to a forage in the field. As one views the multitude that seems so reluctant to leave its domicile, he will see that there are two forms of these termites present, each with its own line of duty; the soldiers with their elephantlike brows and noses, long-legged and more active, act as scouts and guards and see that the way is clear of danger, and the workers, more lowly and less venturesome, that form the bulk of the population of the nest. The soldiers do not have the powerful nippers that characterize this caste in the majority of species of termites, but their retort-shaped heads secrete a fluid which is discharged through the long "snout" and serves to keep off enemies. Nasute

soldiers in the termites are also credited with using this fluid as a cement for constructing the nest.[20]

On the dull afternoon of July 24, 1921, preparations were being made for an excursion. At 4.50 p. m., eighteen snouted scouts appeared on the arigue; they seemed in an undecided frame of mind, advancing, spreading out, retreating; at one moment eight were to be seen, then there were but two, far up the post. Down below and some distance away a mixed crowd of termites was issuing from the ground. Shortly after 5 p. m. none of the insects was visible above; the few scouts were in touch with the guarded line, now apparently well under way; but at 5.50 p. m. it was drawing back, and we could not but mark its caution. Finally, at 6.30, when darkness was coming on, the column with some assurance had ascended the arigue to a considerable height, workers and scouts intermingled, and a few had spread out on the bamboo porch. So the line swelled, two or three workers abreast, well protected by the outfacing guards, and while there may have been some back-and-forth movement, it rapidly climbed upward. Denser and denser it became, the hurrying throng increased to ten or more workers wide, and in addition, a more-open sheet of them had formed on the arigue; but the objective was a large beam along the wall of the room, along which they spread from end to end. Here and there workers collected in groups, biting off tiny splinters and chewing them into a pulp. There were many thousands of these foragers here and no doubt as large a number in the nest. At a quarter to ten they were still pouring out of the ground, but there were also workers, carrying before them in their jaws pellets of comminuted wood, entering the ground. At 10.05 p. m. by far the greater bulk of travelers was still outbound. Here observations were suspended until 6.15 the following morning, when many were still on the beam in the room, but there was a general movement homeward (Plate 5, fig. 2). For a while two little groups of pellet carriers at the base of the post indicated congestion in the traffic, but at last, with a few soldiers properly bringing up the rear, all were safe at home.

The pellet carriers form only a small percentage of the army, because one pellet is the work of many individuals, as we shall now see. The numerous chewers of wood, which do not appear to be of a different caste from the pellet carriers (perhaps

[20] See Sharp, Cambridge Natural History 5 (1895) 370, 371.

the work of both is interchangeable), are intent upon their work, heads applied to the perfectly sound wood, whether it be the beam or the bamboo flooring. Tiny splinters appear and soon a masticated mouthful is collected. Sparse among the mass of termites, workers carrying large or small loads stand around or walk about a little. From time to time one of these is approached by a single wood chewer or by a little group of them; it faces these readily and accepts their contribution stuck on to its load as a little mass of moist, rather stringy, and perhaps regurgitated paste. Thus the burden increases in size, passers-by adding to it until it is deemed of sufficient bulk to be borne nestward. Presumably most of the wood chewers return to the burrow without any apparent load. This work may begin comparatively early in the evening and be maintained up to 8 o'clock or even later on the following morning.

The damage these *Hospitalitermes* do to woodwork seems very superficial for, while they may patronize the same area day after day, the layer removed is almost imperceptible. It is presumed that at least some of this cellulose is used as food, and some perhaps for making the termitarium. Away from human habitations the materials are probably collected from the trunks of trees, and one lot was observed making up pellets from the stem of a royal palm (*Oreodoxa regia*). Sometimes they are very late in returning home, for it may be after midday before all are within; they are, nevertheless, careful to keep their line of march as much as possible in the shade, and the path on which their multitudes pass becomes smooth and well defined. Both soldiers and workers sometimes vibrate the body back and forth. The soldiers are always alert and stand high on their legs, the forepart raised more than the posterior, giving them the appearance, when stopped, of trying to scent danger; they diffuse a rather pungent spicy odor, somewhat like cinnamon; crushed soldiers smell strongly of it, workers little, if at all.

The mouths of an occupied nest are often if not usually shining with the dark-colored inhabitants which frequently overflow it; both soldiers and workers are apparently blind. The large, dark, adult, winged forms, however, are provided with both simple and compound eyes, and come out of the nest at dusk, wander timidly among their apterous brethren, and seem very loath to take wing. One or two very short flights were observed early in December.

To test the aggressiveness of the defenders, an active, long-legged, pale red ant, *Anoplolepis longipes* Jerdon [21] was placed in their midst and near the entrance to the burrow; it hurried away, but I repeated the performance until some of the workers grabbed the ant's legs in their mandibles, the soldiers only pointing or jerking their long noses at it, no doubt with an unpleasant effect. Blowing one's breath upon the termite stream makes it "freeze" or halt instantly in its tracks; then it breaks up in confusion, but in the end the march is resumed in good order. Stirring up the nest immediately brings forth the pungent spicy odor, and some soldiers and workers crawl over the devastating hands, the workers feebly attempting to bite.

One of the larger nests—if, indeed, the several proximate nests were not all joined together underground—was dug up in an unsuccessful attempt to find the queen. The nest was in the hollow of a *Cordia myxa* tree, extending against it partly above ground, and below, following an old root for 30 centimeters or more beneath the level of the soil. Above, there was a sort of embankment of packed earth particles. The body of the nest consisted of an aggregate of thin-walled chambers, dark sooty brown or black, forming a sort of labyrinth, and was crowded with termites. The strong spicelike odor permeated the structure. No eggs were found, though tender, white young, and soldiers beginning to brown up were plentiful. Some of the workers became aggressive, but most of the army ascended the *Cordia* trunk carrying in their jaws many of the young. A few of the latter walking by themselves were not long allowed to do so by their solicitous caretakers. A few of the young (nymphs) had wing pads. The heart of the nest, still farther underground, was not reached. This ruined structure, with its inmates scattered about in wild confusion, was not long in attracting large predaceous muscoid flies of the genus *Bengalia* (*B. latro* de Meijere), as well as other dipterans of smaller size, that flew about with a distinct high-pitched buzz and that did not appear to be of carnivorous habits.

Bengalia is nothing if not bold, nimble, and well able to take care of itself where swarms of ants or termites are concerned. These big brownish flies, which are sometimes over a centimeter in length, are provided with a stout beak terminating in a dilated muscular tonguelike organ strongly armed with

[21] Identified by Wm. M. Wheeler.

longer and shorter bristles. The voracious dipter, posting itself at some fruitful spot near the passing fugitives, suddenly lunges forward and snatches up in its beak one of the young termites, white and tender, carries it nearby, where it is not likely to be disturbed, and in a very short time sucks out its juices. Its appetite seems insatiable; no sooner is one victim disposed of than another is sought; *Bengalia*, indeed, does not hesitate to snatch a young *Hospitalitermes* out of the jaws of its carrier; the latter not infrequently refuses to let go its burden immediately and so both are borne off, the carrier soon releasing its hold, however. Close at hand, among the dry leaves, a nest of an ant (*Anoplolepis longipes*) was disturbed and, much concerned, the workers grabbed their cocoons to transport them elsewhere. Here *Bengalia* was also on the watch; it would quickly seize a cocoon and, usually holding it in the forepaws, pass its length up and down along the end of its beak and suck it until well shriveled, then drop it and be on the lookout for another morsel. Twice there was a tug of war between fly and ant for the possession of a cocoon, the carrier refusing to part with the enshrouded babe, the fly, perhaps unconscious of the third party, thoroughly enjoying the tidbit.

When a flight of termites, or white ants, is on, and scores are attracted to light, *Bengalia* often appears in considerable numbers, making a fairly audible hum. None was seen attacking the termites, although this does happen, as recorded by E. E. Green, in Ceylon [22] and by others. In Africa, *Bengalia* robs *Dorylus*, the fierce driver ants, of their pupæ when on the march; other species of ants are also deprived of their young or of their food.[23] In a similar manner the related *Ochrimyia* [24] of India robs various ants, such as *Lobopelta*, etc.

In the Maquiling forest the somber *Bengalia* is often seen sitting on a slight prominence and shifting beside a column of ants and robbing them of their food or their young. In the case of *Phidologiton*, for example, when carrying termites this is rather easily accomplished, but with the doryline ants

[22] Trans. Ent. Soc. London (1908) XXVI and XXVII.

[23] Lamborn, W. A., and others, Trans. Ent. Soc. London (1913) CXXIII–CXXIX.

[24] *Ochromyia* appears to be a synonym of *Bengalia*. In Africa the larva of *Bengalia* burrows under the skin of certain mammals, including man, and pupates in the ground (see Fox in Insects and Diseases of Man, Blakiston's Son and Co., Philadelphia).

(*Aenictus*) that carry their burdens beneath them and between their legs considerable difficulty may be encountered, as the burly fly is forced to make the attack from the side with many failures resulting.

While *Hospitalitermes* does considerable excavating to accommodate its nest, the work is not done with the precision or the rapidity of true ants; the particles brought up may be very small and apparently in part disgorged from the mouth, or they may be as bulky as the worker itself. In this way a low mound, a labyrinth of burrows, may be formed about the entrance. A small, moderately elongate, deep purplish brown spider with paler legs, in appearance not greatly unlike *Hospitalitermes,* utilizes the earthlike material in the mounds in building a short tube in the edge of the mound roofing and in which it lives; but the spider does not appear to associate itself entirely with the work of this species of termite. What seems to be *Hospitalitermes* also makes covered ways along the trunks of trees.

The habits of termites of the genus *Eutermes,* of which *Hospitalitermes* is sometimes considered a subgenus, have been studied by Bugnion in Ceylon.[25] His figures of *Eutermes monoceros* show that it is closely related to *Hospitalitermes saraiensis* and is referred to as the Ceylonese "black termite." This species has much the same habits as the Philippine *Hospitalitermes,* although the *Eutermes* was noted gathering lichens in its forages. In repairing a breach in their tunnels, the Ceylonese insects were found to use a bit of soil moistened with anal fluid (p. 183). In a photograph (Bugnion's Plate 7, fig. 1) the line of march of *Eutermes monoceros* plainly shows the marginal, outpointing soldiers.

There are other, more or less diurnal Termitidæ. A rather dark Philippine species, though lighter in color than our *Hospitalitermes,* travels like it in the Maquiling forest. On the trunk of a tree in the British Guianan "bush," I have seen blackish termites proceeding during the afternoon in the same style as does the Philippine "day forager;" that is, as a stream, several individuals in width, and flanked by long-nosed soldiers.

Some of the neotropical termites of the genus *Syntermes* are day foragers; Bequaert[26] writes as follows on this habit:

> *Syntermes grandis* (Rambur) and *Syntermes brasiliensis* Holmgren. Both these large species of termites were observed at Vista Alegre, on the

[25] Bull. Mus. D'Hist. Nat. 20 (1914).
[26] Ent. News 36 (1925) 294.

Rio Branco, September 6th. They were foraging in broad daylight and sunny weather, between 9 and 10 A. M. The soldiers and workers had spread over the soil, but not in very large numbers, and were busily engaged in collecting stalks and leaves of grasses and other low plants. The two species, of which *S. grandis* is much larger, were working but a short distance apart, although on quite distinct areas. In each case the termites carried their burdens into a number of large openings leading into deep vertical channels in the sandy soil. The nest itself could not be reached.

Hodotermes havilandi lives in South Africa. It is a grass-cutting termite whose soldiers and workers possess facetted eyes and forage during the heat of the day. Rather large bits of grass are cut off. Haviland, who made these observations,[27] says further that around each nest hole "is a patch over which the grass has been cut quite short." Thus are these termites somewhat comparable to those agricultural ants (Formicidæ), such as *Pogonomyrmex occidentalis* of the Great Plains of the United States, that clear away all vegetation for a considerable radius around their nest aperture.

TRICHOPTERA

CADDIS FLIES

Caddis flies (Plate 3, fig. 1) are four-winged, mothlike insects with very long antennæ and the wings clothed with hairs. The early stages are passed in the water over the surface of which the adults are often seen in swift erratic flight. They are commonly attracted to lights and, indeed, being very early-evening flyers, may appear in an open room before any lights are on. Only one or two species were noticed frequenting houses on Mount Maquiling; a gray-brown kind was rather conspicuous, flying near and under the eaves of nipa shingling, two or more sometimes sporting together. I believe they roost here during the day and form part of the food for the tetragnathous spiders, whose webs often adorn the tips of the marginal palm shingles. The species collected by me, about houses on Mount Maquiling, and identified by Nathan Banks, are *Dipseudopsis bakeri* Banks, *Oecetinella confluens* Ulmer, *Oecetinella apicipennis* Banks, and *Notanatolica gibolensis* McLach.

[27] Teste Sharp, Camb. Nat. Hist. 5 (1895) 384, 385.

NEUROPTERA

MYRMELEONIDÆ

ANT LIONS

MYRMELEON CELEBESENSIS McLachlan.[28] **Plate 7, fig. 1.**

The fine, dry, loose soil beneath the stilted Philippine houses is frequently pitted with little funnellike depressions, an inch or more in diameter, which harbor the squat, sickle-jawed larvæ of the ant lion. These patient creatures pass a great part of their existence at the bottom of the funnel with loose sliding sides, waiting for some insect, most frequently perhaps an ant, to tumble down into their jaws and be devoured. When full-fed the larva spins a roundish silk-and-soil cocoon, from which hatches, in due time, a delicate, long-winged, and long-bodied insect, somewhat resembling a dragon-fly, but of weaker flight and of nocturnal habit. While the large numbers of pitfalls indicate that *Myrmeleon celebesensis* is common, the adults are not very often seen, though occasionally attracted to light or found resting indoors.

Myrmeleon angustipennis Banks is also reported from Mount Maquiling and vicinity,[29] and probably likewise digs into and under the shelter of houses, etc.

CORRODENTIA

PSOCIDÆ

BOOK LICE

This large family of usually minute, winged or wingless insects has been much neglected by entomologists. A few hundred species have been described; probably several thousand exist. They are familiar to most of us as very small, soft-bodied insects, that occur about old books, in dusty places, etc.; most kinds, however, live out of doors, where they are found on trunks, branches, and leaves of trees, on palings, etc. They feed upon the paste of book bindings, dead organic materials, lichens, fungi, etc., and sometimes figure as museum pests in entomological

[28] Identified by Nathan Banks.
[29] Banks, N., Philip. Journ. Sci. § D 11 (1916).

collections. They develop much as do cockroaches and termites, their form changing but little in the successive moults. The psocids are often beautifully marked and strangely formed. The largest species appears to be a South American one, which has a wing expanse of about 2.5 centimeters. Many kinds live gregariously, upon the trunks of trees, on posts, etc., and such colonies are frequently covered by a thin, more or less protective web, that is spun from glands opening into the mouth. There are several kinds of Psocidæ that may be domiciliary in the Philippines; one species, found on a porch post, served as food for *Rhopalum domesticum,* a tiny black wasp. *Myopsocus enderleini* Banks [30] is a rather large, dull brown, winged form that lives in outhouses, etc., at Los Baños. *Atropos divinatoria* (Müller) is the common wingless psocid found indoors in many parts of the world. It is frequent in ill-kept entomological collections. Timberlake has found a tiny myrmarid wasp parasitic in its eggs.[31] Twelve genera and fifteen species have been described by Banks from the Philippines.[32]

LEPIDOPTERA

BUTTERFLIES THAT PATRONIZE THE NIPA HOUSE

Any rural dwelling, the garden of which boasts a few banana plants, palms, and bamboos, is likely to have certain butterfly visitors, chiefly dusk-flying species that pass their early life upon these plants and are drawn to man's abode by the occasional shelter and on account of the lanes of flight it affords. I believe that the houses perched upon the lower slopes of Mount Maquiling are particularly favored by insects of this type, because the greater variety of vegetation there means more food plants and more species.

Such incomplete data as I possess on these butterflies make their treatment here a matter of but a few lines.

NYMPHALIDÆ

MORPHINÆ

AMATHUSIA PHIDIPPUS Linnæus. The "coconut nymphalid." Plate 2, fig. 1, pupa; Plate 3, fig. 3, adult.

At the approach of sunset, a somber brown butterfly, expanding about 10 centimeters and with the hind wings produced into

[30] Identified by Nathan Banks.
[31] See Proc. Haw. Ent. Soc. 5 (1924) 447.
[32] Philip. Journ. Sci. § D 11 (1916).

a short tail, may frequently be observed flitting about nipa houses in a graceful bounding flight, taking this constitutional with some degree of regularity, now circling as far as the back porch and now fetching up among the palms and bananas to the rear. Occasionally, *Amathusia* will enter through a doorway or a window, or it may suddenly abandon its course to pursue some intruder of its own kind. Such antics may be sustained until dusk is well advanced, though I do not think this butterfly is relatively active much after nightfall. Seldom was it seen flying about lights. Shortly before sunrise it flits about for a while, but passes the day on some shaded arboreal perch; not infrequently, however, one would be disturbed beneath the old forestry-station building, where it had been resting under the split-bamboo flooring, or on a beam, or arigue. More rarely is the butterfly found within a house during the day, although it occasionally rests there in the night; then *Amathusia*, head downward, with the wings over the back, may be very closely approached and even captured with the fingers.

Rather late on dull afternoons, one of these insects may be observed carefully laying her eggs on the underside of a banana leaf, on a coco-palm leaf, or on a royal-palm (*Oreodoxa regia*) leaf, the food plants of its larva; the latter like its parent shuns daylight, lying concealed on a bed of silk, spun at the base of a leaf, or other secure and nearby place, whence it sallies forth at nightfall following and augmenting its silken trail to the feeding grounds. Though finally of large size, the *Amathusia* caterpillar is a very quiet creature, not to be discerned at once, as it rests well appressed upon a green coco-palm leaflet. It attains a length of between 7.5 and 10 centimeters, the head is adorned with a pair of fine, spiked, tuberclelike processes, while at the end of the body are two simple processes. The body is green and greenish striped, the head brown and green, and the legs largely brownish. It is rather thinly clad with longer and shorter hair. When full-fed the caterpillar first wanders about for a while, but finally suspends itself by the tail from a palm-leaf petiole, or beneath a raised house floor, and sheds its skin to form a stout chrysalis (Plate 2, fig. 1) about 5 centimeters long and with a bifurcate headpiece; in due time the large brown butterfly, that will again flit in the gathering shadows, is disclosed. There seems to be a continuous round of broods of *Amathusia*.

HESPERIDÆ

"SKIPPERS"

ERIONOTA THRAX Linnæus. **The "banana leafroller." Plate 3, figs. 4, 7, and 8.**

This is a large brownish butterfly with several windowlike spots on the forewings and which expands to about 7.5 centimeters. Like others of the family it is noted for its swift flight. It is one of the several species of Philippine skippers that are chiefly twilight fliers. It has a rather wide oriental distribution and is sometimes numerous enough to damage the banana plants considerably. J. C. Kershaw,[33] in speaking of the adult says:

> The largest Hesperid here, and a very common insect wherever there are banana plants, but it seldom flies much during the day and thus escapes notice. It becomes very active about dusk, flying at great speed about the tops of bananas and other foliage. Occasionally it rests from its wild gyrations on the tip of a leaf, when a mate will often suddenly appear and both will dart off; together. I have captured this insect at flowers as late as 9.00 P. M., and it probably flies much later if the night is propitious.

I have not found these butterflies to be frequent house visitors; occasionally they will rest or sport about beneath a highly raised house. The eggs are hemispherical and well ribbed from the apex and are not quite 2 millimeters in diameter. The little caterpillars cut obliquely inward from the edge of the banana leaf and form a tube by fastening this rolled strip with silk; a large larva makes a large roll as illustrated. Here it also pupates. A full-fed larva is fusiform-cylindrical with a large head set on a small neck, as is usual among the Hesperidæ, and is covered with a whitish flocculent substance. The pupa is often parasitized by chalcid wasps (see Plate 3, fig. 4).

There are several other large skipper butterflies that disport themselves about the house, flying into the rooms and alighting upon the walls or floors; one of these is the coconut skipper (*Padraona chrysogona* Plotz.), whose larva also feeds on the betel-nut palm (*Areca catechu* Linnæus),[34] while another is a very stout species whose larva of bizarre coloration eats the leaves of *Schefflera* and of *Polyscias nodosa* (Araliaceæ).

[33] Butterflies of Hongkong (1907) 127.

[34] See Woodworth, Philip. Agr. 10 (August, 1921).

DIPTERA

FLIES

Apart from the common oriental housefly (*Musca vicina* Macquart) and the far more unpleasant and dangerous green-bottle flies, are a number of Culicidæ, or mosquitoes, and certain others, chiefly parasitic on the prey of household wasps, or on the immature wasps themselves.

In unscreened houses many species of mosquitoes may gain entrance, among which are *Mansonia brevicellulus* Theobald, *Anopheles philippinensis* Ludlow, and *Aëdes* (*Stegomyia*) *variegatus* Bigelow. *Megarhinus amboinensis* Dol. is a very large mosquito with the abdomen of an iridescent blue-purple luster and adorned at the tip with widening tufts of hair. Despite its large size, long beak, and shrill note, it seems never to attack man and is probably only a feeder on plant juices or secretions. The larva of *Megarhinus* is carnivorous and, as it devours the young of other mosquitoes, is thereby beneficial.

Pachyophthalmus signatus Mg. of the parasitic family Tachinidæ was reared from the cell of *Rhynchium atrum*, a eumenid wasp that very commonly nests in houses and stores moth caterpillars, and from which most probably the flies had issued.

Several species of bee flies (Bombyliidæ) are to be found in and about the more-open houses and are parasitic, in such cases, on the immature stages of Hymenoptera. *Anthrax fulvula* Wd. (?) is adorned largely with golden vestiture and has the wings somewhat darkened along the costa and toward the base. One was reared from the nest of the mud dauber *Sceliphron deformis*. *Anthrax* sp. has a blackish body and the wings except about the outer margin overrun with brownish. This species and *Exoprosopa* sp. are also Bombyliidæ that are to be found about houses.

SIPHONAPTERA

FLEAS

Not much interest was taken in preserving fleas, and *Pulex irritans* Linnæus is the only one represented in the collection of household insects.

HYMENOPTERA

BEES, WASPS, AND ANTS

HOUSEHOLD WASPS

The wasps associated with a nipa house in the Philippines are without doubt its most entertaining fauna. They number quite thirty species, not including those that live as parasites upon them. While some are but occasional visitors, others are members of every properly situated household. Since only one or two of the species are of social habit, thus living in communities and defending their nests, with that possible exception nothing is to be feared from wasps in man's abode.

Vespa deusta Lepeletier, a very large paper-making yellow-winged wasp, often inspects the more-open rural dwellings in her search for the nests of other wasps which she robs for her own needs. A smaller, though still formidable species, probably *Vespa luctuosa* Saussure, a useful if clumsy enemy of obnoxious flies, will occasionally commence her paper nest under the eaves of some nipa house where the environment is not too civilized; one such insect, a queen, of course, built several cells from the end of the stout pedicel and laid an egg in each; the work, however, progressed slowly and, while she guarded her nest by resting on the cells for long periods, she eventually deserted this embryonic household.

The genus *Icaria* contains over one hundred kinds of social wasps, on the average of rather small size; they are mainly tropical insects characteristic of the Old World. The carton or paper nests they construct vary much with the species; for example, *Icaria gregaria* Saussure of Australia has a nest consisting of an unprotected comb of more or less oblique cells, hung at one end, and often supported laterally as well, by a strong stem to a leaf, twig, barbed wire, etc.; the affair may vary considerably in shape, and I have seen a long slender one 30 centimeters in length; *Icaria cabeti* Saussure, another Australian species, makes a ball-like nest, a rather small replica of the well-known hornet's (*Vespa*) nest of the more-northern latitudes. In the Philippines are also naked combs of *Icaria* and others of this genus, covered over with an arched carton sheet which, when on the trunk of a tree, may greatly resemble the bark.

These insects, in common with tropical American *Polybia*, sometimes give off swarms which start a new household, although

a single female may also begin such a nest unaided. The severity of the sting is usually in proportion to the size of the wasp—a thing not greatly to be feared, nor yet much to be desired. Like most stinging wasps, *Icaria* is very beneficial in its other habits; the Australian *Icaria gregaria* Saussure often nests in the cane fields where it destroys, among other noxious insects, the sugar-cane leaf-hopper (*Perkinsiella saccharicida*)[35] and various caterpillars.

Several nests of *Icaria cagayanensis* Ashmead were found in and about domiciles at Los Baños. In one case the colony was in a large bamboo upright; in another the nest was situated in the double sawale wall; while a third utilized a large crack formed by the imperfect splicing of a couple of large porch posts, the cells shut in from view by a papery cover.

While the dainty wasps of the genus *Stenogaster* (= *Ischnogaster*) are preëminently forest dwellers, some will occasionally build in outhouses in a woodsy environment. The rather common *Stenogaster depressigaster* Rohwer is one such, as is also a second species, whose nest only was found—several delicate cells strung in couples along a withered vine tip that had forced its way into the top of a small building.

The most noticeable of house wasps are the various mud daubers, representing the families Eumenidæ, Psammocharidæ, Sphecidæ, and Trypoxylonidæ. The Eumenidæ are related to the social wasps and, like the majority of these, keep their wings folded longitudinally in repose. Most of them provision their nests with the larvæ of moths; one Philippine species (*Odynerus luzonensis* Rohwer) preys upon the fat caterpillars of lycænid butterflies, while elsewhere others prey upon the young of certain beetles (*Anthonomus*, etc.) and the larvæ of sawflies (*Hymenoptera*). Eumenidæ that may be domiciliary are represented by eight or more species, with the orange-winged *Rhynchium atrum* Saussure perhaps the tamest and best known. Not gifted with architectural ability, she simply stores some suitable cavity—as within bambo furniture—with small, semiparalyzed caterpillars and plugs up the cells with mud. *Ancistrocerus domesticus* Williams and *Odynerus longitegulae* Williams are two yellow-and-black wasps of smaller size than *Rhynchium* that

[35] *Polybia occidentalis* Oliv., a small, yellow-and-black social wasp in British Guiana, is also a predator upon delphacid leaf hoppers, picking *Neomalaxa flava* Muir from the underside of the blades of a succulent grass.

occur about nipa houses at Los Baños, *Ancistrocerus* having been taken in the act of plastering up a nail hole in a box. These three wasps probably prey mainly upon microlepidopterous larvæ, but the wasps of the genus *Eumenes* are often found storing measuring worms (Geometridæ) in their juglike cells. These wasps are generally recognizable by their slender petiolate abdomen. At least two species, over an inch long (29 millimeters), and a third, smaller one are known to patronize Philippine nipa houses. *Eumenes curvata* Saussure is a fine, polished, black species, with iridescent purple wings and a slender waist, that is at home either in the house or in the forest. *Eumenes fulvipennis* Smith, of equal size but of duller appearance and with pale orange wings, is perhaps more partial to somewhat lower levels, although also a visitor, for nesting materials, to the muddy forest trails. These wasps exercise great circumspection in the choice of their home sites, which may sometimes appear to us as being in ludicrous situations. An egg is suspended in the neat, jug-shaped cell, which is forthwith stored with caterpillars (Noctuidæ, Notoduntidæ), but more especially Geometridæ, or "looper" caterpillars stung to helplessness, this provender being carefully passed through the narrow cell opening by means of the wasp's jaws and first pair of legs; the jug is then stoppered with mud, its short mouth being also disfigured and the whole cell aggregate more or less mudded over into amorphism. *Eumenes fulvipennis* was found to prey upon semiloopers (*Plusia?*) and on Geometridæ, or measuring worms. *Eumenes makilingi* sp. nov. is 14 or 15 millimeters long, black with some yellow marks; its neat little jugs are often found suspended from the loose end of a rattan thong or shredded nipa shingle, beneath a roof. I have not found such cells massed together as in the other two species, though they are deprived of some of their symmetry when stored (Plate 3, fig. 6).

Before leaving the Eumenidæ, attention must be called to the gum-nesting *Odynerus* (*Leionotus*) *xanthozonatus* Ashmead which, while not a mud dauber, is best treated here. This compact little wasp measures 8 to 9 millimeters long, and for a Philippine *Odynerus* has the black ground color strongly predominating over the pale yellow markings. She flies in a brisk manner, and when nearby with a fairly audible hum, and is not afraid to explore the darker places in a nipa house. She has the rather exceptional habit, among the Odyneri, of using a gummy material with a little sand or a sandlike substance intermixed, instead of the ordinary clay for constructing her cells. An ad-

ditional peculiarity of this species is the fact that frequently, if not as a rule, the female passes the night, and also dull daylight hours, in one of her cells. Such a cell is rather elongate, and narrowed and slightly curved at the mouth and, being of comparatively large size, affords plenty of space for the wasp, her egg or young larva, and for some of the caterpillar provender. She likes to build within houses and seems to be on the wing, though in varied numbers, throughout the year. I found but three nests or cell groups; secluded spots are chosen, and a row of six horizontal cells glued on the underside of a light table and shared by two wasps during June and July, 1921, furnished most of the data. Another nest was built in an old mud-wasp cell in a hole in a house post, while a third fitted the angle of two walls. The cells are provisioned with small, paralyzed moth caterpillars, which may be of several species, and are "passed" into the cell, the wasp facing the aperture and using the forelegs and probably also the mandibles in the operation. A single egg is fastened by a short filament to the wall at the end of each cell, and the young grub (Plate 3, fig. 2) feeds on the caterpillars within its reach, at first in a suspended position, but soon drops in among them and in a few days consumes the lot. The grub may be a day or more old before the mother seals up the cell by making a wet-looking, gum-and-grain disk. Two pupæ that I reared took about twenty days to develop into mature wasps.

During March, 1922, one of these *Odynerus* was observed preying upon the partly grown larva of a small moth that disfigures and rolls up the shining young leaves of *Eugenia jambolana* (Java plum) on the grounds of the College of Agriculture. The spry young caterpillar, in attempting to escape from one end of its rolled-leaf retreat, is usually seized in the jaws of the alertly pivoting wasp, and then is more or less paralyzed by stinging and carried nestward.

This species is of interest in constituting one of the ever-increasing array of solitary wasps known to throw some light on the origin of the social habits among the Hymenoptera. She has something in common with the large black *Zethus cyanopterus* of the Philippines,[36] although she does not partly masticate the caterpillar prey so that the tender wasp grub may more easily devour it, nor wait until this grub is full-fed before closing up her cell. Although these *Odynerus* are not friendly to one

[36] See Williams, in Philippine wasp studies, Bull. Haw. Sugar Planters' Assoc. Exp. Sta. Ent. Ser. 14 (1919) 157 et seq.

another, they may nest side by side with their cells in contact. This habit recalls somewhat the compound nest of the South American *Zethusculus lobulatus* Saussure, where each wasp has her own cells.[37] Evidence points to the cells of *Odynerus xanthozonatus* being cleaned of débris for further use. *Odynerus tropicalis* Saussure of Africa is more advanced than *Odynerus xanthozonatus*, in that she tends her young until full-fed and frequently nurses several young at one time.[38]

The mud-daubing psammocharid wasps (Pseudageniæ) that may frequent houses are represented by several species that are often far more secretive in their nesting habits than are the Eumenidæ. The large black *Macromeris violacea* Lepeletier, with iridescent, violet-black wings, while occasionally entering dwellings in search of the large, active crab spider (*Heteropoda regia* Fabricius), is more a denizen of trees, in the hollows of which she usually constructs her shapely oblique cells. *Ageniella unifasciata* (Ashmead) very often builds her row of mud cells in plain view on some wall, whereas a larger species of *Pseudagenia* plunges mud-laden into a large and perforated bamboo wall support, so that an inspection of her nest is rendered impracticable.

Many kinds of spiders seek food and refuge within the nipa house, although the shelter thus afforded is not in every case all that could be desired. *Psammochares analis* (Fabricius), a medium-sized black wasp with clear wings and the abdomen tipped with orange, sometimes invades such houses in search of

[37] See A. Ducke, Zool. Jahrb. Syst. 36 (1914).

Here also may be mentioned *Montezumia infundibuliformis* (Fabricius), whose habits were observed in the lowlands of British Guiana during late 1923. It is a rather large black and brown wasp with transparent wings that attaches its mud cells to the trunks or limbs of trees or to other vegetation. These cells are comparatively large and thick, but the short, curved neck and the slightly flaring-lipped mouth are more delicate. The wasp egg is about 4 millimeters long and is fastened to the cell wall by a filament less than a millimeter in length. The store consists of small moth caterpillars, paralyzed and unmutilated, and these, at least for the earlier part of its life, are fed periodically to the wasp grub. The mother wasp eventually seals the cell with mud; hatched cells may be used over again, the emergence hole being enlarged and lipped anew. Two females may occupy cells side by side, as was noted in a row of five contiguous cells, passing the night head outward in the commodious chambers that also harbored young wasp grubs and their food.

[38] Bequaert, J., Vespidae of the Belgian Congo, Bull. Am. Mus. Nat. Hist. 29 (1918) 185, 186.

crab spiders, probably closely related to *Heteropoda*. One afternoon in November, 1921, something was heard to fall to the floor from the ceiling of my room, and on looking down I beheld an *analis* wasp battling with a medium large spider that, finally managing to get upon its own back, strove to repulse the gingerly active hymenopteron with its nimble legs; the wasp, however, soon stung it to paralysis, fed (?) at its juices, and after a few short flights dragged it away, presumably to her nest under the house. *Psammochares analis* is not a mud dauber, but excavates funnellike depressions in the loose soil, storing each with a parasitized spider.

Four species of the familiar sceliphronine (Sphecidæ) mud daubers nest within Philippine houses. All are spider catchers, storing many victims in each cell. *Chalybion violaceum* (Fabricius), while the most showy in a garb of metallic blue, is the poorest architect of the lot; it is perhaps more domiciliary than the others and in season abundantly evident on bamboo porch railings, etc. The female selects a convenient nest cavity, such as a nail hole, an old nest of one of its relatives, the hollow of a spool, penholder, chair-rung socket, etc., stores it with spiders and, laying an egg on one of them, stops up this cell with moist earth, which is covered over with a mixture formed in part of the excreta of some small animals, in this case of lizards. The cocoon period may be of some months' duration. *Chalbyion* passes the night and unfavorable weather on a carefully selected object—in one case, several patronized the loop of some brown string suspended from a porch; this roost was finally abandoned, probably because of ants, the bane of wasps.

Of the three species of *Sceliphron*, the small *S. conspicillatum* (Costa) (*madraspatanum* of Bull. 14) is the tamest. It seems addicted to the lowlands, while *Sceliphron deformis* (Smith) and *luzonensis* Rohwer (= *interudens* of Bull. 14) are often seen in the forest. *Sceliphron deformis* is very common in some houses, where it ordinarily constructs its barrel-shaped cells within the bamboo walls. *Sceliphron luzonensis*, less frequent and of larger size, is a more-circumspect insect, often securing her massive ball-like mud nest far out of reach on some vine, wire, palm leaf, etc. She spends considerable time in exterior decorating, working upon her apparently completed nest for days and days.[39]

[39] Kohl in his work on *Sceliphron*, Ann. Naturhist. Hofmus. 32 (1918), devotes about twenty-eight pages to the life histories of these wasps.

The wasps of the family Trypoxylonidæ in the Philippines are the long slender species of *Trypoxylon*, and the rather thick-set *Pison*. There are several kinds of *Trypoxylon* about Los Baños, and they are familiar insects, mud gathering on the forest trails of Mount Maquiling. Very few observations were made on the household activities of this genus but it is known that at least one small species sometimes nests in holes in house posts. Two or three species of *Trypoxylon* wasps, observed biologically in the Philippines, simply partition off preexisting cavities with mud to make cells which they provision with spiders. Some of the American species are no better architects than these oriental ones, but there are others of the former that make very delicate and attractive nests. Many of the Trypoxylonidæ lend themselves easily to transportation in commerce; it is not surprising, then, that the little *Trypoxylon philippinensis* Ashmead has reached the Hawaiian Islands, where it very commonly nests indoors. So too with *Pison*; both *P. argentatum* Sh. and *iridipennis* Smith occur in the Philippines as well as in Hawaii, the former often constructing little filagreed mud cells arranged in a cluster upon some root, or lodged consecutively in some angle of a building. A *P. iridipennis* was found nesting in a hole in timber, as was also *P. luguense* Ashmead, a shining and coarsely punctured little wasp. All hunt spiders, stuffing a number in each cell.

There are other wasps, mainly of small size, that frequent nipa houses, very often taking advantage of the cylindrical borings of post-and-bamboo beetles (largely of the families Bostrychidæ and Scolytidæ) for nesting places. One such wasp species, sometimes abundant on a beetle-perforated arigue in a sunny exposure, is the little black *Polemistus luzonensis* Rohwer, 1919 (Pemphredonidæ), measuring about 5.5 millimeters long and with a strongly sculptured head and thorax. Numbers of these insects, presumably males, may sometimes be observed flying up and down a post as if seeking the opposite sex. *Polemistus* preys upon aphids, or plant lice, and what is almost certainly this wasp is sometimes to be seen searching the figs of the common lowland *Ficus nota*, for the active, pale green to brownish, little plant louse that hides and feeds at the more or less protected bases of the crowded fruits. The wasp flies about such figs, finally alights upon one of them and carefully approaches her prey, as if in full knowledge that it has some natural means of defense, for she may stop and falter in her purusit, evidently

repulsed by some scent or fluid given out by the posterior cornicles; the aroused aphids, on their part, hurry to the base of the fig but sooner or later one of them is suddenly seized by the fore end and immediately borne off nestward. Here is a post, punctured shotlike, with little beetle borings, some of which now serve as *Polemistus* nests, for occasionally a female wasp perches, aphis-laden, at a hole and, this being too narrow to admit both wasp and aphid simultaneously, the feebly living provender is placed at the entrance and apparently pushed within, the wasp following. Sometimes, however, she backs in to tuck in her prey with the tip of her abdomen. When fully stored, the boring is sealed flush with the surface with a translucent, resinlike substance. This insect is not without its enemies, the most-conspicuous one being a large handsome metallic green chalcid wasp (*Ecdamua* sp.), with an ovipositor that may exceed 16 millimeters in length or over three times as long as the remainder of the insect; with this implement she pierces the sealed *Polemistus* nest to parasitize the cell contents. Such are the bare observations on this chalcid.

A stout and alert little fly (*Milichiella*), nearly all blackish in the female but in the male with a satiny white abdomen, was very often seen on this particular porch post; but its business there, further than that it often investigated the little beetle holes therein, and before sundown backed for a millimeter or two into one of these holes, was not ascertained.

The family Crabronidæ contains a varied assortment of large-headed wasps that in the main store their nests with flies. Several species nest or hunt about nipa houses. *Crabro makilingi* sp. nov. is a rather stout insect, about 6.5 millimeters long, that stores small flies (in the case observed) in a deserted termite tunnel in a bamboo upright forming a house support. The genus *Rhopalum* is made up of small slender wasps with pediciled abdomen, that often tunnel pithy brambles or old stumps. Some species store aphids or spiders, and the Peckhams [40] studied two species that provisioned their nests with small gnats. This habit of storing midges—in this case, of the families Mycetophilidæ and Cecidomyidæ—was also observed by Nielsen with *Rhopalum clavipes* in Europe.[41] This

[40] Instincts and habits of the solitary wasps, Bull. Scientific Ser. I, Wis. Geol. & Nat. Hist. Surv. 2 (1898).

[41] Videnskap. Meddel. fra den Naturh. Foren. 1 Kyoenharm (1900) 262.

insect, however, has a diversity of tastes, for Bouwman [42] found *Crabro* (*Rhopalum*) *clavipes* storing *Psocus bifasciatus* (Corrodentia); likewise, I noted the Philippine *Rhopalum domesticum* sp. nov. capturing insects of the latter group. For several weeks one or two males of this little wasp were noticed flying up and down a certain portion of a veranda post, and at times making an exceedingly brief stop on its surface. Several of this sex were captured and it was presumed that their localized movements concerned the female, perhaps to issue from a beetle boring in the post. On January 12, 1922, on a porch post opposite the first, a large area was webbed or sheeted over by a colony of Corrodentia, or "book lice," over which hovered a female *Rhopalum domesticum*, and when thus on the wing attempted to snatch up a victim; but here her efforts were fruitless, for the silken web protected the colony beneath from such haphazard aggression. Finally, however, the wasp alighted on the web and succeeded in biting a hole through it and had nearly pulled out a victim when, for fear of losing her, I captured her.

The very small larrid wasps belonging to the genera *Nitela* and *Rhinonitela* (Williams, 1927), being nesters in holes in wood, can be found on the outermost parts of buildings. *Nitela bicornis* Williams and *Rhinonitela domestica* Williams [43] were taken on veranda posts, and one or the other of these species was pulling a bit of dried soil, presumably to plug her nest hole. *Nitela* sp. is known to store plant lice and Corrodentia, or "book lice." Among the larger and typical Larridæ *Dicranorhina luzonensis* Rohwer is an occasional visitor in rooms and quite addicted to running along the bamboo porch railing, window sills, etc. She nests, however, in the soil, often beneath a house on poles, and stores her burrow with little wood crickets. *Notogonidea subtessellata*, less bold than *Dicranorhina*, occasionally nests in flower-pots in outhouses; so also may a *Tachysphex* sp., in such earth containers on porches.

Of the fine big larrid wasp *Liris aurata* (Fabricius), plentiful in the Philippines, Maxwell-Lefroy says:[44]

> It is very often found haunting houses, especially store rooms, in search of house crickets. The latter are notorious domestic pests attacking provisions, etc. This wasp, in frequenting dwellings, performs the part of an efficient natural check on these domestic pests.

[42] De levende Natuur. Amsterdam 16 [8] (1911) 176.
[43] Bull. Haw. Sugar Planters' Assoc. Exp. Sta. Ent. Ser. 19 (1927).
[44] Indian Insect Life (1909) 202.

Wasps of the genus *Chlorion* are typical, loud-buzzing Sphegidæ that frequently attain a length of over 2.5 centimeters. They prey upon orthopterous insects, which they bury usually in the ground. *Chlorion aurulentus* (Fabricius) var. *ferrugineus* (Lepeletier) is the one of the several Philippine species of the genus observed by me that likes to hunt and even to nest and roost in the neighborhood of nipa houses. The short burrows of these wasps are to be found in the dry soil sheltered by the eaves, or in outhouses, and sometimes a female loudly inspects the nipa ceilings for the lurking brown grasshopper (*Gryllacris* sp.). These solitary wasps are not wholly without sociability, for they pass the night clinging, often in some numbers, to a bunch of dead leaves, or to seed pods. A piece of cord depending from the porch eaves made a satisfactory bed for one of these wasps, her blue mud-daubing relative *Chalybion violaceum,* and a large fly. The record dormitory consisted of a coarse ribbonlike band of straw about 2.5 centimeters wide and 30 long, hanging near a shower bath beneath a nipa house. One evening forty-two *Chlorion aurulentus* wasps were counted roosting on this strip. Such roosts are patronized night after night. Bedtime may be early in the afternoon, depending much on the kind of weather.

The Bethylidæ are all small, usually brownish to black wasps that generally prey upon the larvæ of beetles and of small moths. Five genera were found represented in houses at Los Baños, as follows: *Epyris, Desepyris, Perisierola, Sclerodermus,* and *Cephalomomyia.* These wasps make no nests and their presence in houses is to be explained by the fact that their prey frequently occurs in similar environment. A fat-bodied, wingless female of *Sclerodermus immigrans* Bridwell, of insignificant size will rarely find her way—probably by falling from the ceiling—upon one's person and inflict a sharp little sting. This insect almost certainly parasitizes the grub of one of the "bucbuc" beetles (Bostrychidæ or Scolytidæ) that may seriously injure bamboo structures by their perforations and which attack other woods as well. *Sclerodermus immigrans* Bridwell,[45] described by him from the Hawaiian Islands [46] and also iden-

[45] Proc. Haw. Ent. Soc. 3 (1918) 484, 485.

[46] Because of its close alliance with certain other species, Timberlake, Bull. Bishop Museum 31 (1926) 19, is inclined to regard *S. immigrans* as an endemic Hawaiian species.

tified by him from Philippine material [47] was found by Bridwell on the lowlands of Oahu breeding on various coleopterous larvæ, whereas his researches, among others, show that the endemic Hawaiian *Sclerodermus* attacks chiefly wood-boring moth caterpillars.

The genus *Sclerodermus* also occurs in houses of bamboo structure in the Neotropics, as noted in Ecuador. *Cephalonomyia* includes very small wasps. Bridwell [48] found a Hawaiian species attacking the larva of *Hypothenemus*, a scolytid beetle that bores twigs. *Perisierola emigrata* Rohwer is a species inhabiting the Hawaiian Islands, which attacks small moth larvæ, including those of the pink bollworm (*Pectinophora gossypiella*).

The Chrysididæ, or cuckoo wasps, are very hard-shelled insects adorned with brilliant metallic, blue-green or ruby, that are parasitic in the nests of solitary wasps and bees, being very partial to the cells of mud daubers; they thus occur in houses. They do not defend themselves by stinging, but by curling up tightly. The largest Philippine species and the one commonly parasitizing the cells of *Rhynchium atrum*, the common household eumenid wasp, is *Stilbum cyanurum* Forster.

HOUSEHOLD BEES

The bees that may patronize Philippine houses are not so numerous in species as are the household wasps. In point of size the carpenter bees of the closely related genera *Mesotrichia* and *Xylocopa* are the largest. Probably more than one species tunnels house posts or beams, but the yellow-and-black *M. ghilianii* (Gribodo) at Lake Lanao, Mindanao, is the only one I observed frequenting houses.

CTENOPLECTRA VAGANS Cockerell.

Castalia obsoleta Chevrolat is a rather large and handsome, purplish blue and red buprestid beetle that tunnels the wood, perhaps among other kinds, of *tamayuan* (*Strombosia philippinensis*), a valuable forest tree that occurs in the Mount Maquiling region, where it is often employed in buildings as arigues, or house posts. One such arigue, that was or had been thus infested, supported a corner of the roof and veranda of a house on the mountain slope. *Ctenoplectra vagans* Cockerell, a thickset bee about 20 millimeters long, with a brillant blue abdomen, was active about this post, as it utilized the deserted galleries

[47] Op. cit. 2: 291. [48] Op. cit. 305–308.

of the beetle, while *Parevaspis abdominalis* Smith was more rarely seen; the latter is a less swift, nude-looking bee with a red abdomen, an undoubted parasite of *Ctenoplectra*. The late Dean C. F. Baker very kindly gave me one of his *Strombosia* arigues so that the timber could be split and sawed, and the interesting complex more thoroughly examined. The larva of the buprestid, like most of its kind, tunnels the wood chiefly along the grain and, having a much-flattened and widened thorax, makes a boring, oblong in cross section. It is a very slow-moving insect and obviously must feed for a long time in such a dry and innutritious medium before it can obtain sufficient food to complete its transformations. That part of the tunnel which turns off toward the exterior of the post and opens through it is in section subcylindrical, or a spherical triangle, for it represents the pupal chamber and the path of the differently shaped adult beetle in boring its way to freedom. It is this part in the main that affords good nesting places for bees and wasps; the bore fits *Ctenoplectra* and its parasite very well. These two bees are much alike in size and general shape, but even a cursory examination shows them to be very different in structure. *Ctenoplectra* somewhat recalls in color and size the familiar *Osmia*, spring bees of many temperate regions, and is highly modified in vestiture and legs for its special work; the other, with the red abdomen typical of many parasitic bees, is very sparsely hairy and has ordinary-looking legs quite unfitted for gathering pollen or nest materials.

During March, well along in the dry season, *Ctenoplectra* appears about certain house posts, zigzagging rapidly and with a high audible buzz while hurriedly searching for vacated borings. She alights before a tunnel, pokes in her head, withdraws it, and takes wing. A suitable hole is at last found, and presumably is cleared of any débris and, if necessary, made more cylindrical, not by additional boring in wood, but by filling in with or drilling through sawdust, the work of a beetle larva. In due time this tunnel is divided, as stored, into a few cells, the walls of which are commonly lined with a dark waxlike material. Each cell is supplied with well-packed, orange-colored pollen, which I suspect is gathered from the plentiful *Hibiscus* flowers nearby, an egg deposited on or near the provender, and the chamber stoppered with a plug of sawdust or earth, impregnated with the waxy or gumlike substance. In due time the egg hatches into a little larva which rapidly matures

on the pollen, spins a rather thin, brownish, tissuelike cocoon, and changes into a pupa in a few days; or the larva may enter upon a resting stage lasting several months, embracing winter and a part of the dry season. Then the larva loses its activity, becomes rather flaccid and yellow, and assumes a curled position, as do many other hymenopterous larvæ under similar conditions. With the coming of the warm season, bringing with it more available moisture, it changes into a pupa, in shape much like a mummified bee, with sawlike ridges between the segments on the back of the abdomen. The pupal stage is always short, and soon the perfect bee gnaws its way out to freedom. *Ctenoplectra* is nervously active and works rapidly. The deep orange pollen is pasted on to the outer surface of the broad hind tibia and first hind tarsal joint, both densely bristling with long, mixed simple and plumose hairs. It is this same apparatus that also carries grains of soil; the broad shearlike spur with its close-set comb teeth, and springing from the inner side of the hind tibiæ, no doubt helps detach a load and clean the outer tibial surface. A pollen-laden bee on arriving at her tunnel peeks into it, backs out, turns around, and then enters tail first.

The closing of the cell is an interesting operation. *Ctenoplectra* alights on the dry powdery soil, gathers some of it with the inner surface of the middle pair of legs—an examination of which indicates that it is the broadened, first tarsal joint, fittingly provided with well-arranged hairs, that performs this task—and transfers the load to the hind legs, now raised off the ground. She finally accumulates a noticeable load, carries it nestward, backs into the tunnel, and employs the hind legs as well as the abdomen in sealing the cell. If the cell be close to the surface, she can be seen tamping with the end of her body (which is provided beneath near the tip with divided rows of fine, soft, apparently glandular hair) and gradually meanwhile turning around so as to treat all the space. Perhaps the sticky material is carried on her hind legs, as their condition sometimes suggests, for they are rubbed against the walls of the cell which are finally wax (?) lined; the soft silky abdominal hairs may possibly also play a part here and secrete a sealing material. When the cap cover is in place it is noticeably moist.

A dispute over a tunnel may involve a tussle between two bees. A pollen-laden *Ctenoplectra* was seen to penetrate, head first and for half her length, a tunnel in which another of her species was lodged head outward; a brief tête-à-tête took place,

the outer bee first pulling back slowly and then with a jerk until her rival was completely hauled out; they held each other's mandibles and let go only when on the wing; the ousted bee immediately reëntered the tunnel, the other one flying off.

The parasitic bee *Parevaspis abdominalis* inspects the arigue holes, occasionally entering one; apart from this, nothing was learned of its habits. Bingham [49] says: "*Parevaspis* is parasitic on the leaf cutter bees (*Megachile*). I have seen *P. abdominalis* entering the nest of *M. disjuncta.*"

Another parasitic bee that sometimes patronizes house posts is a fat little black-and-yellow *Stelis* sp., which genus elsewhere is known to parasitize the nests of bees of the genera *Osmia* and *Dianthidium.*

A short-tongued, mainly black bee, *Prosopis luzonica* Cockerell,[50] is an occasional visitor to the veranda and may nest in holes in posts, and the little *Heriades sauteri philippinensis* Friese [50] is also a patron of nipa dwellings.

One or more leaf-cutter bees (*Megachile*) are to be expected in houses, using a suitable crevice in which to make their leaf-bit cells; in fact, one was discovered nesting in a rattan and bamboo chair in a room.

The social bees of the Philippines are represented by the genera *Apis, Bombus,* and *Trigona. Apis indica* merges into *A. mellifera* Linnæus, the common honey bee that is kept for its honey and wax and is rather widespread in the Islands. *Apis* (*Megapis*) *binghami* Cockerell and *dorsata* Fabricius are two much larger and "undomesticated" species. In India *Apis dorsata* is said to build its comb in and on various portions of buildings, such as in double walls, under wooden staircases, on marble arches, etc., and, being of a fierce and pertinaceous disposition, often renders these buildings untenantable.

Apis florea Fabricius is a rather small species that extends into the Malayan region at least as far as Java. Bingham (1897, p. 557) reports seeing a nest of this species "under the eaves of the roof of a forest bungalow."

Bumble bees (*Bombus*) dwell in the cool mountains.

Trigona biroi Friese belongs to a group of social bees usually of small size (hence the term "mosquito bees," sometimes applied to minute species), far better represented in tropical

[49] Fauna Brit. Ind., Hymenoptera 1 (1897) 499.
[50] Identified by T. D. A. Cockerell.

America than in the Orient; three species have been recorded from the Philippines.[51] While incapable of stinging, some kinds can make themselves very disagreeable by getting into one's hair, particularly when their hind legs are laden with a gummy substance. The Philippine species in question is a small black one, 4 or 5 millimeters in length, that is widely distributed in the Islands and builds its nest in a variety of situations. In Dumaguete, Negros Island, I have seen a nest in the joint of a large bamboo, and it probably builds on occasion in favorable places in buildings. The meliponine bees, including the genus *Trigona*, may produce considerable honey. Their food habits, however, are not always cleanly.

HOUSEHOLD ANTS

As far as numbers are concerned, ants are an exceedingly successful group of insects, a fact particularly true in tropical regions. Some species exist only in a special environment, but others are adapted to a wide range of conditions and are thus found in houses, on shipboard, etc. The more-specialized forms and those incapable of a strong defense cannot, as do a number of other endemic insects, withstand encroachment by cosmopolitan species that invade their habitat. It would be quite out of place here to give even a brief account of the salient features of the life of ants, their variety, classification, etc. Only a few species that may live in or occasionally invade Philippine houses will be dealt with. Needless to say, ants are a great pest to man in the Tropics, and in the houses it is a matter of constant vigilance to keep them away from foodstuffs and other desiderata, and in some places it is distinctly uncomfortable to scale a tree without first taking its ant fauna into account.

The subfamily Dorylinæ includes the famous legionary, driver, and visiting ants that are particularly conspicuous in Africa, and South and Central America, some of the species of which often invade houses and rid them of vermin. They are therefore beneficial in their predatory habits, though their bites and stings are frequently severe. The females are large, sluggish, and very rarely found; the workers are active, blind, and of several sizes, the largest with immense mandibles; the males are winged, comparatively large and wasplike, with the eyes highly developed. The Philippine species observed sometimes paying the nipa house

[51] Cockerell, T. D. A., Philip. Journ. Sci. 14 (1919) 77.

a brief visit belong to the genus *Aenictus,* rather small, wiry, blackish ants apparently with no major workers which, though blind, race along in very narrow and orderly columns in search of the nests of certain other ants—as do those of *Anoplolepis,* probably leaving the fiercer species alone—which they raid particularly for the sake of the young. These ants do not concern themselves with man's foodstuffs; but, after having attended strictly to their particular prey, soon leave the premises.

The Ponerinæ are a family of primitive ants that nest usually in comparatively small colonies. The larger species may sting severely. Most kinds live away from the habitations of man, but several large ones (*Odontomachus, Odontoponera,* and *Diacamma*) are able to endure a great deal of civilization. The species of *Diacamma* are usually blackish in the worker sex, with the very dissimilar males pale yellowish or yellowish red, and provided with wings and long antennæ. They nest in convenient hollows in trees, under bark, logs, etc., and cover the entrance over with a sort of curtain of interwoven débris. They are timid insects and easily repulsed by certain comparatively small species.

For some time a small colony of *Diacamma rugosum* Le Guill. subsp. *geometricum* Smith var. *viridipurpureum* Emery [52] occupied a rather precarious nesting place in the extremity of a termite-eaten beam supporting the back of the porch of the old forestry building at Los Baños. For a while they held their own, but eventually vacated their dwelling, probably in favor of other ants. Their new habitation was soon discovered for, upon pushing my foot into a rather moist tennis shoe that had been left on the sunny porch to dry, I felt a sort of scrambling movement within. The shoe was hurriedly pulled off and a quantity of *Diacamma* dislodged. Both shoes were occupied by a total of about twenty of these large ants, with their larvæ, a cocoon, and a dead bug as provender. In one of the shoes a nest covering consisting of masses of dust, dry bits of leaf, etc., had already been made. The tennis shoes of two neighboring parties were similarly seized upon by these ingenious ants whose presence within was less agreeably hinted at than in my case, by a few effective stings in the pedal extremities. In *Diacamma,* as has been shown by Wheeler and Chapman [53] from

[52] Identified by Wm. M. Wheeler.
[53] Psyche 29 (1922) 203–211, 4 figs.

a study of the Philippine *D. australe*, the egg-laying function is assumed by one of the workers, differing not at all from her fellows excepting that she is made capable of reproduction. The genus is peculiar to the Indo-Malayan and Australian regions.

The subfamily Myrmecinæ has two nodes to the pedicel of the abdomen and embraces perhaps the most pestiferous and domiciliary of all ants. Many sting very efficiently as, for example, the "fire ant" (*Solenopsis gemminata*) and the agricultural ants (*Pogonomyrmex*). Some of the most annoying of Philippine ants are one or more species of *Phidologiton*, which live in immense communities and, despite the small size of the ordinary worker, bite very feelingly. It is this ant that one sees crossing forest paths in columns studded with the shining and comparatively immense "soldiers" and also patronizing the numerous decaying figs of *Ficus nota* on the lowlands. They nest rather deeply in the ground, sometimes beneath houses which they may so invade as occasionally to drive the occupants from their beds. They are both granivorous and insectivorous.

At least three species of *Tetramorium*, identified by Doctor Wheeler, frequent houses about Los Baños. They are *Tetramorium* sp. near *simillimum* Roger, *T. guineense* Fabricius var., and *T. pacificum* Mayr. One ant, probably of this genus, was never observed except in small numbers, dwelling in a knot hole or beetle boring in house posts. It had a sluggish, crouching gait and was fond of visiting one's tooth brush. When pressed and rubbed with the finger it finally breaks into three pieces. *Atopula ceylonica*,[54] related to *Tetramorium*, was found in the winged form in a house at Los Baños.

Tetraponera attenuata F. Smith (*Sima attenuata* Smith) is a very slender, polished, black ant of wide Malayan distribution, that is occasionally found in houses, but which more commonly nests in twigs and other hollows in trees. The ants of this genus are powerful stingers and are mimicked by attenuated spiders and, in the case of *Sima rufonigra* Jerdon in India, by *Ampulex constanciae* Cameron, a sphecid wasp that preys on cockroaches.[55]

The genus *Monomorium* contains some cosmopolitan species that very frequently infest houses, where by their small size they are able to gain entrance into very narrow spaces. No

[54] Identified by Wm. M. Wheeler.

[55] See Bingham, Fauna Brit. Ind., Hymenoptera 2 (1903) 110.

list of Philippine house-inhabiting species was made, though it is to be expected that *M. floricola* Jerdon var. *philippensis* Forel, *M. pharaonis* Linnæus, *M. destructor* Jerdon, and *M. minutum* Mayr may be listed here. *Phidole* and *Cremastogaster* should also occur in buildings.

The subfamily Dolichoderinæ has at least one disagreeable little black ant that is to be found particularly in vine-laden houses. *Dolichoderus* (*Hypoclinea*) *bituberculatus* (Mayr)[56] is a lover of honey dew and may be present in such numbers upon certain trees and bushes attending mealy bugs, tree hoppers (Membracidæ), etc., as to make the inspection of such plants very unpleasant. They do not sting but nip rather capably and squirt out a fluid smelling like rancid butter, from the end of the abdomen. They are found stringing along bamboo railings, arigues, and wires for the transmission of electricity. They are also about at night. They often rest (?) on the march and are then found in groups or camps along their pathway. Their nest may be located in a bamboo joint in a house, between two leaves fastened together by a sort of rough carton, etc. When disturbed they become very irascible and rush out of their nest and stand in a challenging manner, jaws open and body raised off the ground so as to bring the tip of the abdomen forward and up, to discharge the unpleasant fluid. Despite their aggressiveness, a certain tiny fly causes them much concern. Once I observed some of these ants carrying on in an aggravated manner, for the minute dipter was flying over and about an ant, now and then darting down and occasionally touching it, apparently on the thorax. The fly attempted to touch the same ant more than once. An attacked *Dolichoderus,* instead of moving along, at first assumed its offensive pose, with jaws wide open, and started angrily at each touch, but when the fly kept repeating its tactics the victim stampeded. Presumably this little fly parasitizes these ants.

The Camponotinæ include ants of very high mental and social order and species of such genera as *Formica,* the biology of which has been much studied in temperate regions.

Oecophylla smaragdina (Fabricius) lives in trees where, using its larvæ as spinners, it constructs a silk and leaf nest. It is a most decidedly unpleasantly biting ant that occasionally gets on porches through the medium of wires or vines. A

[56] Identified by Wm. M. Wheeler.

rather exhaustive account of this ant in India is given by Hingston.[57]

Anoplolepis longipes[58] Jerdon is an active, long-legged, yellowish ant, commonly seen running about floors. It nests in old, eaten-out planks, between débris and plants, etc. Though of slight build it is able, through an anal fluid, to hold its own in the ant world and to prey upon comparatively large insects, such as winged termites.

Paratrechina longicornis Latreille are abundant, particularly in outhouses. They are inquisitive, rather small, very active blackish ants which, when flooded out of their outhouse abode, as by water from a hose, will scale the walls and there, high and dry, queens in their midst, wait until the danger is past.

The carpenter ants belong to the genus *Camponotus* and dwell chiefly in dead wood which they hollow out to some extent and often protect the more-exposed portion of the nest with a crude sheet of débris. They are rather large ants with two or more castes in the worker sex, one having very massive heads, and the other constituting effective defenders of the colony for, when disturbed, they rush out and fiercely pinch any offending object. In the Philippines, I have found *Camponotus* (*Tanaemyrmex*) *irritans* F. Smith subsp. *obfuscatus* Vieh[59] in a house, and it is probably the species that nested in old house timbers, remaining in seclusion during the day and sallying forth at night in search of food. Winged male and female *Camponotus* are often attracted in annoyingly large numbers at lights, sometimes, it seems, almost to the exclusion of other insects.

Additional species of ants are attracted to lights—here may be mentioned *Camponotus* (*Colobopsis*) *leonardi* Emery[59] and species of *Polyrhachis*. The latter genus is represented in the Philippines by many species, the majority of which inhabit the forest, where their nests of silk and débris are often found on trees. Some species, such as *Polyrhachis* (*Myrmhopla*) *acantha*[59] dwell in more-open country and are sometimes found in and about houses. The members of this genus are very commonly armed with a few more or less conspicuous spines.

[57] Journ. Bombay Nat. Hist. Soc. 29, Parts 1–3, 363 et seq.
[58] Identified by Wm. M. Wheeler.
[59] Identified by Wm. M. Wheeler.

DESCRIPTIONS OF NEW SPECIES OF WASPS

EUMENES MAKILINGI sp. nov. Plate 2, figs. 2 and 3.

Female, type.—Length to end of second abdominal segment, 13 millimeters. Slender. Black, with pale yellowish markings as follows: A pair of large, almost fused spots at base of clypeus, wedge between antennæ, inner eye margin from near base of clypeus to large part of emargination, narrow strip behind eyes, pronotum with a dorsal band, notched posteriorly in the middle, and with an adjoining lateral band on anterior margin, mesonotum with a lateral stripe anterior to the tegulæ and two pairs, one below the other on the pleuræ, small spot on posterior part of tegulæ and posterior angles of scutum, a pair of wide, more or less fused spots on metanotum, and two pairs of spots on propodeum, apex of fore and middle femora, and most of fore and middle tibiæ, mid and posterior coxæ on outer side, and a small dorsal stripe on hind tibia, dorsal apical margin of pedicel, spot each side second abdominal segment, a subapical band on second abdominal tergite, and a double spot near apex of second abdominal sternite; teeth and apex of mandibles reddish; wings moderately infuscate. Generally smooth and polished; puncturation scattered and rather shallow, best developed on upper part of frons, on pronotum, mesopleuræ, propodeum, and second abdominal segment, the segments following sparsely and very finely punctate; clypeus gently emarginate, mandibles with four teeth, third joint of antenna nearly twice as long as fourth; thorax short, stout, rounded fore and aft, without processes, except the drawn-out posterior angle of scutum, propodeum bilobed by reason of the longitudinal foveate median line; pedicel slender, about equal in length to head plus thorax, the spiracle on a slight swelling at about middle length, second abdominal segment drawn out a little petioliform where it joins the petiole and raised ringlike on the yellow band before the thin, slightly reflexed posterior margin of tergite. Wings with the two recurrents entering the second submarginal cell about equally distant from the middle, second submarginal cell subtriangular, narrow along the marginal vein, third submarginal much larger than second. Vestiture: Some erect hair, white on face and sides of thorax, propodeum, and abdomen, pale brown on notum of thorax.

Male, allotype.—Length to end of second abdominal segment, 11.5 millimeters. Much like the female though more heavily and deeply punctured, particularly on thorax and with the clypeus entirely yellow except the gently emarginate apex and the entire eye margination yellow. Antennæ well hooked; spiracular tubercle on pedicel better developed than in the female.

Type, from Los Baños, Luzon, February, 1922; allotype, Zamboanga, Mindanao, October, 1921, *F. X. Williams;* paratypes, 2 males and 1 female, Los Baños, Luzon, *C. F. Baker;* 1 male, Los Baños, Luzon, 1925, *C. E. Pemberton;* and 1 female, Los Baños, Luzon, November, 1922, *F. X. Williams.*

In some specimens the thoracic bands are more or less interrupted.

ODYNERUS LONGITEGULAE sp. nov. Plate 6, figs. 2 and 4.

Female, type.—Length to end of second abdominal tergite, 10 millimeters. Of medium build. Black and polished; yellow as follows: Clypeus (except a median stripe and front margins), base of mandibles, scape beneath, small spot between antennæ and a large one just above this spot, invagination of eyes and a stripe on cheeks, front of pronotum, a pair of hooklike markings (recurved outwardly) on scutum, tegulæ except submedian spot and margin, a large spot on sides beneath wings, two spots on scutellum and most of mesonotum, apical sides of propodeum, forelegs, except most of trochanters and of coxæ and part of femora, the second and third pairs of legs less yellow but more brownish; wings lightly infuscate, abdomen with a band on first four segments, a pair of lateral spots on first segment; in addition, the mandibles are mainly brownish, of which there is also a good deal on the legs, and the spot and margin of the tegulæ are pale semitransparent brown. Head about as wide as thorax; mandibles 5-dentate, the fifth or basal tooth from lower side of fourth; antennæ with joint 3 distinctly longer than 4; clypeus nearly or quite as long as wide, the distal produced part truncate and slightly emarginate; between the bases of antennæ the frons is longitudinally raised and finely carinate in the middle, sculpture of deep, rather large punctures, though the disk of clypeus is medially more or less irregularly longitudinally wrinkled; punctures very close on frons, tegulæ especially elongate; the propodeum has three teeth at its latero-apical angles, the uppermost tooth giving forth a delicate carina that runs back toward base, the sides of propodeum in a great measure of exceedingly fine reticulate appearance and

with some wrinkles at sides, posterior face with trace of fine median carina and fine, not very distinct, oblique striæ; wings with marginal cell rounded from apex and slightly appendiculate; abdominal segments 2, 3, and 4 particularly strongly punctured, especially at apex where the punctures are rather deep, margin of second tergite well reflexed. The transverse furrow on second sternite is not carinulate but more or less punctured, while mesially from its posterior edge runs a short impressed line. Vestiture sparse, mainly silvery golden pubescence.

Type, 1 female, from Los Baños, Philippines, June, 1917; paratype, 1 female, same locality, June, 1921, *F. X. Williams.*

The paratype lacks the small spots on the first abdominal tergite but has a pair of small spots on the second sternite. The first abdominal tergite is also less strongly reflexed.

This insect has somewhat the appearance of *Odynerus vespoides* Williams (1919), which has the marginal cell likewise somewhat rounded apically and slightly appendiculate.

ODYNERUS (LEIONOTUS) XANTHOZONATUS Ashmead. Plate 6, figs. 1 and 3.

Odynerus (*Leionotus*) *xanthozonatus* ASHMEAD, Proc. U. S. Nat. Mus. 28 (1905) 962.

The male is much like the female; the antennæ are hooked at the tip, and additional yellow markings are as follows: Basal curvature of clypeus (instead of merely both basal sides), stripe on first antennal joint beneath, and the tarsi, more or less basally. The mandibles have four teeth; and the median pit or depression behind the ocelli, which in the female has a raised and arched posterior border, is here subobsolete.

This insect has a fondness for building in and about dwellings of the more open type, and the nest-building material is mainly a resinous substance.

ANCISTROCERUS DOMESTICUS sp. nov. Plate 6, fig. 6.

Female, type.—Length to end of second and abdominal tergite, 7 millimeters. Moderately slender; black and polished; yellow as follows: Clypeus, mandibles, first two antennal joints, spot between antennæ, within eye emargination, back of the eyes above, two spots on pronotum, tegulæ, posterior scutal angles, metanotum, legs except coxæ and trochanters and portion of the hind femora, posterior margin of first abdominal tergite, and both tergite and sternite of second abdominal segment; flagellum of antennæ brown beneath; wings lightly infuscate. Head

about as wide as the middle of the thorax, squarish behind the eyes; mandibles (with tip broken) probably 5-dentate; antennæ with joint 3 distinctly longer than 4, the flagellum clavate; clypeus nearly or quite as long as wide, the distal truncation gently excavate; between the eyes at the base of the clypeus the frons is longitudinally swollen and sharply carinate for its distal portion; elsewhere the frons and genæ are very closely and rather coarsely punctured (= reticulate); the vertex, particularly the ocellar area, has much finer and sparser punctures, with the occiput with large separate punctures; ocelli but little sunken, arranged in a low triangle and posterior to them a a small median pit. Thorax coarsely and closely punctured with a reticulate effect; posterior face of propodeum excavate, with a fine median carina and mainly with sparse scattered punctures except dorsally and down the sides where it is deeply reticulate; drawn out into a pair of thorns at the sides and near the base and with a still more basal place; second submarginal cell nearly triangular and receiving the second recurrent quite near its outer edge; third pair of coxæ with a flat thorn on the postero-lateral angle. Abdomen with two transverse carinæ on basal half of first tergite; transverse notch in second abdominal sternite with 10 or 11 longitudinal carinulæ, posterior to this sternite it is rather suddenly and well raised. Abdomen with rather scattered though distinct punctures above and below, at least on the first three segments—the other segments being well retracted. Vestiture, very sparse and yellowish.

Described from 1 female that was plastering up a nail hole in a box in a house. Los Baños, Philippines, March, 1921, *F. X. Williams.*

This may be the female of *Odynerus imbecillius* Saussure, from Java.

CRABRO MAKILINGI sp. nov. Plate 6, fig. 8.

Female, type.—Length, 6.5 millimeters. Rather stout, except that abdomen is subpetiolate. Black, with yellow as follows: First antennal joint, raised posterior pronotal ridge (reddened by cyanide?) and the lobes, scutellum (also with two brown spots), and a large part of the tibiæ and tarsi; the mandibles largely reddish, while a part of the antennæ and the tegulæ are brownish. Sculpture delicate. Mandibles bidentate at apex; clypeus subtruncate and gently trilobed at apex, a central carina not attaining margin; antennal sockets

touching each other and, outwardly, the eye margins, joints 2 and 3 about equal, 4 longer; eyes widely diverging toward and subemarginate at vertex; ocelli in a low triangle, the anterior ocellus the smallest and separated from the others by a little less than its diameter, the posterior ones distant from the compound eyes by about the diameter of each; head shining and with very fine separated punctures; mesonotum and metanotum with rather fine separate punctures, denser anteriorly on scutum; propodeum more polished and only weakly punctured and with a weak initial basal carina, a well-marked posterior fovea and a fine bounding carina on sides, a fine transverse carina on sides before mid coxa. Wings with truncation of marginal cell a little oblique, first recurrent vein joining first submarginal cell very slightly before middle. Abdomen with the first segment forming a short petiole, with fine, well-separated punctures and the sides finely keeled to apex; pygidium subtriangular, about as long as wide, compressed, though not finely drawn out nor excavate at apex, the lateral margins low, a well-defined median carina, the disk rather dull and coriaceous. Vestiture, silvery pile on the clypeus.

Type, 1 female, Los Baños, Philippines, September 9, 1917, *F. X. Williams;* nesting in an old termite tunnel in wood and storing flies. Paratypes, 3 females, same locality, July and August, 1921. The paratypes have no brown on scutellum.

RHOPALUM DOMESTICUM sp. nov. Plate 6, figs. 5 and 7.

Female, type.—Length, 5 millimeters. Slender; polished and black, with yellowish white as follows: First antennal joint, lobes of pronotum (except spot), tegulæ in part, first and second pairs of legs, apical part of hind coxæ, trochanters and base of tibiæ of hind legs, and basal part of pedicel of abdomen; mandibles largely reddish and flagellum and apex of abdominal segments brownish, with posterior margin of pronotum more or less testaceous. Mandibles bidentate at apex; clypeus with a prominent lobe on each side of middle, and with lateral angles sharp; a median beaklike process just above and against antennal sockets; frons smooth, narrow, and excavate for the antennæ; antennal joint 2 longer than 3, which is a very little less than 4; eyes strongly diverging toward vertex; ocelli arranged nearly in an equilateral triangle, the fore ocellus a little the smallest, all separated from one another by less than their diameter, and from the compound eyes by more than their diameter; a fine impressed line from each posterior ocellus to

eyes; vertex and thorax with fine separate punctures; propodeum almost without punctures, a few basal carinulæ, a posterior face fovea, and below it toward pedicel a carina and some transverse carinulæ; marginal cell obliquely truncate; first recurrent vein running into first submarginal cell beyond middle; abdomen finely coriaceous. Vestiture, silvery on clypeus.

Male, allotype.—Length, 4.5 millimeters. Like female, except clypeus, which is subtruncate with the lobes very much reduced, thus forming rounded outer angles, and a shallow median excavation, lateral angles not so prominent.

Type, 1 female, Los Baños, Philippines, January 12, 1922; allotype, male, same locality, September 10, 1922; paratypes, 4 males, same locality, June and August, 1921, *F. X. Williams.* Preys on Corrodentia (book lice).

COLEOPTERA

BEETLES

HOUSEHOLD BEETLES

Unfortunately, not much attention was given this order of insects as occurring in dwellings, although they exist there in considerable variety. Large numbers may be attracted to lights, causing some annoyance by their erratic gyratory flight. After the lights are turned off, flashing fireflies (Lampyridæ) are often seen high under the dark apex of the roof. At least several species may thus occur in houses, a common one with a strong luminescence being *Colophotia praeusta* Eschscholtz, a pale brownish insect 7 or 8 millimeters long; another is a species of *Luciola,* of lesser size and with black elytra, while a third is *Vesta* sp., rather large and wide, red and black, and but feebly luminescent. Outside in the fields by the roadside or along the river additional species occur, and one may come upon a beautiful sight in a wayside tree fairly scintillating with their numbers. As adults, certain fireflies are carnivorous, but many of the more delicately formed kinds are undoubtedly plant feeders, wholly or in part. The larvæ prefer moist places, and the Los Baños ones are common along Molawin River, a small stream arising from the slopes of Mount Maquiling. Their luminescence is usually inferior to that of the mature insect. Snails form the principal food of many of the larvæ (that is, those with a slender form and greatly extrusible head), and they do

not confine their hunt to the ground but may be found on some bush as well, the head and part of the thorax inserted into the shell of the victim (Plate 3, fig. 5), which they paralyze with a single nip of the jaws.

Of very commonplace aspect but of great economic detriment are the *bucbuc*, the Tagalog name for certain boring beetles of small size, generally belonging to the families Bostrychidæ and Scolytidæ. These are stout cylindrical insects with rounded or subtruncate extremities that form their "shot-hole" tunnels in wood, both as young and as adults. The bucbuc that perforate the bamboo work of a house, particularly when this wood is not well seasoned, are especially injurious, as the quantity of wood dust beneath the attacked portions indicates.

Dinoderus minutus (Fabricius)[60] are among the chief "shot-hole" offenders, and they quickly ruined some long straight pieces of stem of *Schizostachyum lima* bamboo that I had brought into my room. Their borings were 1.5 millimeters in diameter and about 35 long. Woodworth[61] mentions three Bostrychidæ; namely, *Dinoderus brevis* Horn, *Dinoderus minutus* Fabricius, and *Heterobostrychus aequalis* Waterhouse, as attacking species of bamboo. Other beetles, such as the larger *Xylothrips flavipes* Illiger (Bostrychidæ) and Scolytidæ, attack the posts, or arigues, of forest timber. A species of domiciliary *Sclerodermus*, a small wasp, wingless and antlike in the female sex, no doubt parasitizes the larvæ of the lesser bucbuc, while the much larger *Xylothrips* seems to have an enemy in the slender metallic blue beetle (*Cylidrus cyaneus* Fabricius) of the predatory family Cleridæ, which may from time to time be seen entering beetle borings in posts; here belongs also *Tillus someranus* (Gorham), a red and black species often common in houses and on house posts, and the cosmopolitan *Tarsostenus univittatus* (Rossi).

The still larger bostrychid *Heterobostrychus aequalis* Waterhouse sometimes breeds in the wood of boxes, and has been taken thus in Manila.[62]

At least two species of powder-post beetle, *Lyctus* sp. and *Minthea rugicollis* Walker of the family Lyctidæ, occur in Phil-

[60] Identified by F. C. Hadden.

[61] Philip. Agr. 10 (1921) 13.

[62] *Heterobostrychus aequalis* and *Dinoderus brevis* have been reared from bamboo shipped into England. Tomlin, Ent. Mo. Mag. III 11 (1925) 94.

ippine houses and, if we include insects affecting stored products, a number of other beetles will be added to the list.[63]

PRIONOCERUS CAERULEIPENNIS Perty. Plate 2, figs. 4, 5, and 6.

The family Melyridæ is closely allied to the Malacodermidæ, which contains the majority of luminescent beetles. It is not surprising, therefore, to find that the power of producing light is not wholly lacking in the Melyridæ, as exemplified by the common *Prionocerus caeruleipennis* Perty (Plate 2, fig. 4) of the Philippines and elsewhere. The beetle in question is 10 to 12 millimeters in length, with a reddish pronotum, and deep metallic blue to greenish wing cases. Perhaps fully matured specimens are nonluminous, but larvæ, pupæ and, to a slight extent, callow adults are light-bearing. My first acquaintance with the luminescent property in *Prionocerus* was the finding at dusk of its rather elateroid, prong-tailed larva, on November 8, 1920, in a ravine. Some weeks later, one evening after retiring I noticed a shining spot on the coat rack in my room and, on examining a suspended garment there the following morning, found an actively wriggling *Prionocerus* pupa hanging from the shrunken larval skin that was loosely secured to the coat. It yielded an imperfect adult. Rather well-grown larvæ (Plate 2, fig. 5) were found in the evening near Molawin Creek, Mount Maquiling, Los Baños, where they occurred as a rule on pieces of wood and twigs. The body is rather stout and depressed and the large head bears a pair of strong jaws that suggest a carnivorous habit. The fore part of the head is rich brown, the base pale brownish white, with a curved line across it; the main part of the body above is a sort of wood brown; the anal process is forked and roughened and blackish brown in contrast to its whitish base and preceding segment. The body has sparse erect pale brown hairs. The larvæ, one of which was 15 millimeters long, are active and with greenish luminescence distributed as follows: A rather diffused lateral spot on the mesothorax and methathorax, a large strong spot on each side of the eighth abdominal segment, and segments 5, 6, and 7 have two pairs each, the upper small and more anterior as well; 4 has one upper spot, and 3, 2, and 1 of abdomen each a pair of spots rather low on the sides. The pupa (Plate 2, fig. 6) at first showed a greenish yellow glow throughout the body with the head more strongly luminous, but as it approached ad-

[63] See Woodworth, Philip. Agr. 10 (1921) 35.

olescence only the head end and the sides of the abdomen shone, the rest being dark or nearly so. Five days after its discovery it was still luminous in its head and tail portions but more distinctly so toward the head where there were two lateral prothoracic and one basal, pronotal area. The freshly hatched adult is only faintly luminous, the glow best developed on the prothorax, back of the wings, and a little on the abdomen.

The adults appear to be phytophagous, a number having been seen nibbling the anthers on the inflorescence of a palm tree.

VERTEBRATES

FROGS IN HOUSES

POLYPEDATES LEUCOMYSTAX Gravenhorst. The banana frog, palacang saguing. Plate 7, fig. 3; Plate 8, fig. 4.

This common and widely distributed frog is known to almost everyone who lives away from the madding throng. It resembles in form and in some of its habits its smaller relatives, the pretty green or brown tree toads (*Hyla*) of the United States. A good-sized banana frog is about 7.5 centimeters long in head and body and, though varying in color, is usually a sort of olive brown with darker body stripes. It is much less timid than are many frogs and not very aquatic.

It is an expert climber and likes to rest in the shade on leaves of large size, like those of the banana, the Manila hemp, or abacá (*Musa textilis* Née), and heliconoids, and is not averse to selecting a cozy place in a house as a temporary habitat. One of these amphibians chose the damp folds of a bathing suit hung upon a bamboo pole on a porch of western exposure, as a fitting place in which to cool off. At night it becomes active, and after contemplation moves along in 1.5-meter leaps, jumping very quickly in through the open door and on the wall or table. It may rest for some minutes on the vertical woven bamboo wall. No doubt it is attracted by the insects that fly to light. Its croak is dry, rather harsh and suppressed, and not very loud. The eggs are enveloped in a mass of foam which becomes hard-crusted in the sun; these masses are suspended from twigs, leaves, stones, etc., over or above water, and I found many such plastered on the cement walls of a water trough; some of the masses just reached down to the water, some were partly immersed, and others still well above it. The tadpoles, on hatching about three days later, have only to wiggle down by gravity to the lower edge of the white mass, break through it, and drop into the water

and there complete their transformation. In the frothy egg masses are often found the maggots and puparia of a good-sized muscoid fly.

Polypedates leucomystax has a representative, perhaps more domiciliary than itself, in North Queensland, Australia. It is *Hyla caerulea*, a green frog (despite its specific name) that reaches a length of 10 centimeters. Its snout is blunter than that of the banana frog and it seems less active. It was rather numerous about the veranda of the house where I lived for a couple of months, and toward evening several would leave their place of concealment between or on top of the shaded beams, and either crawl about the house posts in a series of pausing advances, or else surprise one by the loud "plop" of their leap from on high to the cement floor. I was told that this frog, which at certain times of the year often roosts in houses or about porches in considerable numbers, inflates itself preparatory to its fall! When alarmed or seized by its natural enemies it gives forth a shrill and startling cackle, evidently calculated to confuse its foe.

According to Taylor,[64] over fifty species of the genus *Polypedates* are known, and seven of these have been recorded from the Philippines.

LIZARDS IN HOUSES

Lizards are among the most-constant representatives in a tropical house fauna. Some, as the skinks, are common only in country places, and even then can scarcely be called domiciliary, but many of the Geckonidæ are satisfied to spend a lifetime in buildings where conditions are favorable to their existence.

Foremost in size and reputation among the Philippine Geckonidæ and a veritable surprise to the new traveler in the oriental Tropics is the "talking lizard" or *tukko-tukko* (*Gekko gecko*) of the Filipinos. This reptile, the ruler of the ridge pole (Plate 3, fig. 10), is perhaps more often heard than seen for, well hidden within a sawale wall, or resting on or inside a lofty bamboo pole, it sends forth a stentorian call that strongly suggests the word "gecko," leisurely repeated some half dozen times and often varied with a sort of rapid stutter or a growl. It is an unhandsome, large-headed creature of anæmic aspect, though powerfully muscular, that measures from about 20 to 25 centimeters in length.

[64] Philip. Journ. Sci. 16 (1920) 213–359, 10 pls., 9 text figs.

It is somewhat variable in color, but is usually a sort of pale, lead gray spotted with brick red, the tail more or less banded with dark (Plate 8, fig. 1). The body is roughened, but scales are hardly apparent, and the large eyes dirty pale greenish yellow with a vertical black iris. The feet have well-expanded sucker disks beneath the toes which enable it to climb vertical walls and ceilings. The large jaws are lined with numerous small teeth and, although the gecko always tries to escape an enemy, it becomes aggressive when seized and will then take hold of any offending object in a bull-dog grip, which is not loosened until it feels there is a chance for escape. While typically a house lizard, the gecko is also to be found in forests, or hidden away among bowlders or scrubby trees, or in some remote grass area. It does not talk much, on an average perhaps not more than two or three times daily; it thus sets a worthy example to those persons who are prone to excessive verbosity. The call of the gecko, however, has a range of several hundred feet and, when emitted from within a bamboo joint that operates as a sort of sounding box, seems specially loud. Although the vertical eye slit points to a nocturnal life, the gecko may, under the stimulus of the sight of food, become active during the daytime in its somber home under the apex of the roof (Plate 3, fig. 10). A house seems never to abound with this lizard, as it usually does with members of smaller species, which may occur in dozens therein. However, when a feast is in promise, such as a substantial flight of white ants, attracted to light, more geckoes than were thought to exist there may clamber down from the roof and partake of the repast; but it seems not at ease on the floor and is loath to descend among its smaller cousins which are boldly stuffing themselves on the fat insects. As regards prey, however, size appears to be no insurmountable object; it becomes very eager for the chase when large sphinx moths, in seeking security, or even small birds in searching for safety flutter about its ridge-pole habitat. The burly, hard-shelled coconut beetle (*Oryctes*) sometimes falls a victim to its rapacity, as testified by the loud raps, when the lizard in its endeavor to separate the wheat from the chaff strikes the insect against the bamboo to free it of its indigestible armor. The morning after shows the thorax and elytra of *Oryctes* on the floor below. Much larger objects may also be attacked, such as small rats, and the occasional fall of a snake from the ceiling may be due to its unsuccessful seizure on the part of a gecko.

The eggs (Plate 8, fig. 3), as I found them, are laid in batches; they are white, hard-shelled, and somewhat rough to the touch. Normally they are symmetrical and about 12 to 13 millimeters thick by 22 to 23 long; but, space not permitting, some may be so squeezed against their neighbors—they are evidently flexible at extrusion—as to yield to pressure and to fit an end or side into some distorting notch or angle. Such little batches of eggs were found very firmly glued inside of a bamboo node in an outhouse and also at the base of a palm petiole. In emerging, the young, banded-tail gecko makes a rough hole in the shell. Like its parent, it is then quite ready to bite when seized, and holds its jaws agape.

Gekko porosus Taylor [65] occurs in the Batan Islands, northern Philippines, where it may inhabit houses.

Smaller species of Geckonidæ that measure 10 to 12.5 centimeters long are the best known of household lizards. In British Guiana they go by the name of "wood slaves." In the Philippines, *Peropus mutilatus* is the common, fat-tailed house lizard, with *Hemidactylus frenatus* also abundant. *Cosymbotes platyurus* is likewise domiciliary, although all three, with probably other species as well, are equally at home in hollow trees, under bark, or in rocky ledges (Plate 7, fig. 4, a species from Ecuador). The tails of these lizards are very brittle and may snap off when that member is seized, to rejuvenate, often in a fantastic manner, as two or more tails in place of one. The lizards produce their calls mostly at sundown and these are varied, whether according to mood or to species I do not know; sometimes the sound suggests a tiny mocking laugh, or a noise made by knocking together two little marbles; again it may simulate a half dozen sharp kisses or, finally, serve as a good substitute, on a rather small scale, for the clicking noise one makes with the tongue and cheek when desirous of urging old Dobbin along. While insectivorous, they are in some localities also fond of sugar, and of nosing among flowers, and here I have in mind the "ohia lehua" (*Metrosideros polymorpha* Gaudichaud) of the Hawaiian Islands that they will seek indoors, probably for the nectar these blossoms secrete. In India house lizards have also been known to eat cooked rice and biscuit crumbs.[66] They do not always exhibit skill in catching their prey, often pondering and pausing over an intended

[65] Philip. Journ. Sci. 21 (1922) 187.
[66] Journ. Bombay Nat. Hist. Soc. 27: 408.

victim which may thereby escape; on the other hand, a combination of haste and inexperience that brings unpleasant results may be shown in their dealings with stinging insects, as was demonstrated one night in March, 1922, as follows: In examining by electric torch light a carton nest of a small social wasp (*Icaria cagayanensis*) that was built in the loose splicing between two posts of a veranda, I noticed one of these geckoes making some half-hearted attempts at catching a wasp or two that stood by the doorway of the nest; the wasps got away, however, evidently stinging or otherwise repelling the reptile which, thereby becoming cautious, licked its chops and carefully sniffed (it seemed) at them, and no longer essayed their capture; nay, it even backed away from an advancing wasp.

They will seize large insects, or those possessing large wings, and strike their victims from side to side against the object upon which they are resting, and this explains the knocks of a determined nature that may be heard on the walls of an evening. The geckoes quarrel considerably among themselves and thus often fall together to the floor. The pretty little white eggs have brittle shells and, as observed, are not very far from being spherical. They are deposited often loosely, in some suitable hollow, as a knot hole or crevice, or under a piece of loose bark.

Some interesting observations on *Hemidactylus flaviviridis* Rüppell, a common Indian house lizard, are published by Baini Parshad.[67]

VARANIDÆ

The "monitors" are generally large to very large, elongate lizards that inhabit the Old World; *Varanus salvator* Laurente (Plate 7, fig. 5), which ranges from the East Indies to Cape York, Australia, may, rarely, attain an extreme length of 2 to 2.5 meters. It is a common species in the Philippines, where it often attracts unfavorable notice by its depredations among poultry. It is an expert climber, runner, and swimmer, and its haste when on the ground may be very noisy. While oftentimes seen in the forest, the Philippine monitor lizard, or *bayawak*, is quite at home in more-open country and there, among other things, seeks out the chicken coops and garbage dumps as sources of food. Unlike the iguana of the New World, it has

[67] Journ. Bombay Nat. Hist. Soc. 24: 834–838, 1 pl.

its rather snakelike head on a long flexible neck, and because he did not put this anatomical fact in the foreground, a member of the teaching staff at the Los Baños College was severely bitten on the hand by one of these lizards that had designs on his poultry and which he had grasped too near the shoulders. That the reptile runs many hazards during its lifetime seems to be attested by the frequently abridged condition of its tail, or by some other mutilation. Occasionally it will share man's domicile with him, provided a safe and secluded shelter can be found in it; thus, for several months a small specimen took up lodgings in the double wall in one of the old forest-station buildings and made considerable noise going to and from its quarters. In houses it has some reputation as a rat catcher.

The skink lizards (Scincidæ) are casual in houses. They are sleek, alert, and swift. Such lizards climb nimbly and like to bask in the sun. We find them on the verandas and railings, and indoors on various beams in the nipa houses, and seeking refuge within the double walls. *Sphenomorphus jagori* is a rather small brown skink with a distinct lateral stripe from behind the eyes. *Dasia smaragdinum* is greenish anteriorly above and mainly bronze on the rest of the body. Both lizards may occur in and about houses. Ants seem to be one of their common foods, but I saw one of these skinks in my room, where it was devouring the slender luminescent centipede that is common indoors; the squirming morsel gave some trouble, and much scraping and shaking of it were necessary before it entirely disappeared.

BIRDS IN HOUSES

Birds that of their own accord live in houses in the Philippines are not many; the only truly domiciliary kind observed was the common sparrow (*Passer montanus* Linnæus) some of which nested in the open end of a large bamboo pole that helped support the steeply wedge-shaped ceiling of one of the Mount Maquiling nipa houses. Of this species, McGregor says in part: [68]

> The first land bird to greet the visitor to Manila will doubtless be a fringillid, *Passer montanus* (Linnæus). This species is a native of Europe that is now well established in Manila and in many of the towns along the railroads or that are reached by water transportation . . . This

[68] Philip. Journ. Sci. 16 (1920) 364.

sparrow may be seen in small flocks along wagon roads and railroads and in old fields at some distance from houses. At first sight the mountain sparrow is easily mistaken for the European house sparrow, *Passer domesticus* (Linnæus), but the two species are sufficiently distinct. The former does not seem to increase with the rapidity of its less favorably known cousin and is not so great a pest.

Birds in captivity are more numerous and, apart from domesticated canaries, we find the *puñalada,* or blood-breasted pigeon (*Phlegœnas* sp.), and the *colasisi* (*Loriculus* spp.) in cages. The colasisi is a species of "bat parrakeet," so named from its habit of passing the night suspended, batlike, from some limb, using one or both feet for the purpose. Once I saw a huge hornbill tamely sitting on a window sill of a nipa house in Mindanao.

Among animals above the floor, one may sometimes see a monkey (*Pithecus* sp.), a rather ill-favored creature that lacks much of the brightness and manner of its tropical American cousins.

THE HOUSE BATS

Bats are mammals belonging to the order Chiroptera (Greek for hand wings), and are readily distinguished by the possession of true wings, the fore limb being greatly lengthened as a framework for the alar membrane, which also extends to the hind member and usually to the tail. The thumb is free and useful in helping the animal to crawl about; the feet have the full number of toes and are employed chiefly in suspending the body for rest. While the eyes are frequently very small and almost buried in the fur, they are efficiently supplemented by whiskers, by acute and often greatly developed ears and other facial membranes, and by the sensitive skin of the wings. The character of the teeth indicates the general nature of the food of bats, which may thus be divided into frugivorous and insectivorous species; in the former the cheek teeth have smooth crowns and are longitudinally grooved, while in the latter, with but few exceptions, the crowns of these teeth are surmounted by sharp cusps divided by transverse grooves. However, many of the so-called insectivorous bats, including the blood-sucking vampire (*Desmodus*) of the American Tropics, have a mixed diet and consume both animal and plant food, while a few others (*Megaderma*) are known to feed upon their smaller fellows and to capture small fish and even amphibians. *Megaderma lyra,* the Indian vampire bat, is said to feed habitually

on birds and mice, chewing them up in the corners of rooms or verandas.[69]

Bats make no nests. The female bears one or more young of comparatively large size, which cling to her body when she is at rest and usually in flight. Thus the weight she carries is sometimes excessive. Vernon Bailey[70] points out that the weight of the several young sometimes exceeds that of their mother.

The habits of these animals are of considerable interest. Some congregate during the day in immense numbers in caves, buildings, or hollow trees; some assemble in small numbers and others are solitary. The same roosting places may be patronized for day or weeks, or they are the inheritance of generations. In countries with a cold winter bats hibernate; elsewhere they are usually active the year round. In most kinds the flight is swift and graceful, but some of the larger frugivorous species fly rather heavily and directly, and in flapping their wings produce a noise comparable to the flexing of a large piece of coarse paper. The Megachiroptera, which contains the single family Pteropodidæ, comprises the fruit eaters and includes the largest of bats, some of the "flying foxes" (*Pteropus*) of the Indo-Malayan region attaining a wing expanse of 1.5 meters or more. Such bats roost during the day in immense numbers in undisturbed regions, in mangrove swamps, bamboo thickets, or other, more or less inaccessible places, and sally forth at sunset to their feeding grounds, often many kilometers away, seriously to depredate fruit trees or injure other vegetation, and return to their "camp" before sunrise. Wild figs constitute a favorite food of frugivorous bats, and in the Philippines, and probably elsewhere as well, the natives who appreciate the flying foxes as good eating sometimes capture them as they fly about the great canopies of fig-laden trees, by tearing their wings with the long, slender and cruelly barbed flagellæ, or whip lashes, of the rattan palm (*Calamus*). *Vampyrus spectrum*, a false vampire and the largest bat of the American Tropics, is perhaps mainly a fruit-eating species, with an ugly countenance and a wing expanse of about 75 centimeters.

There are many smaller species of Megachiroptera, and in the Philippines the chief ones, found about Los Baños nipa

[69] See F. Gleadow, Journ. Bombay Nat. Hist. Soc. 17 (1922).
[70] National Geographic Magazine (September, 1925).

houses at night, measured from 30 to 50 centimeters in wing expanse and belonged to the genus *Cynopterus* (Plate 8, fig. 2) of the Pteropodinæ. These animals, of which there may be several species, have rather pleasing features for, while the nostrils diverge in a bifid manner, the eyes are large and soft and the head is well formed. *Cynopterus* was observed roosting singly or in small groups; one large ill-scented fellow was taken from the hollow of a leaning tree well up in the Mount Maquiling forest, while three others were observed suspended from a dome-shape retreat formed by the underside of the crown of a small fig tree and with the darkening aid of some vines. They are voracious feeders and, while eating certain large leaves and wild fruits that I did not identify, the principal food, at least in the vicinity of the residences on Mount Maquiling, seemed to consist of the wild figs *Ficus hauili* Blanco and *Ficus nota* (Blanco) Merrill. These two species are small trees abundant along the lower edges of the forest; *F. nota* bears large masses of good-sized fruits on the stem and thicker branches, while in *F. hauili* they are smaller and solitary on the branches. Both trees are diœcious, as in the figs of commerce, the true seed figs being borne on one plant and the gall and male ones on another. While such figs are quite insipid to us, *Cynopterus* devours them in large quantities and, as far as my observations go, always selects the female or seed fruits for its repast. Several times these bats were seen to flutter over the crown of a *hauili* tree and, selecting a fig, seize and detach it with some effort and fly heavily away with it to a convenient roost. Such roost may be used over and over again and for more than one successive night, and is commonly located by the accumulation of seeds below and which the animal passes, its digestive and assimilating processes being very rapid. *Cynopterus* is not an unfamiliar bat in open houses that adjoin woods. The ceilings over verandas, or the underside of the roof of rooms are often chosen for its dining place as having the advantage perhaps of shelter from wind and rain. With a weighty fig held in wide-expanding jaws it flies up under the roof and, hooking on to the palm shingling by means of the long strong thumbs, suspends itself head down and, employing one or both hind feet and its upturned head, readily manages to eat the fruit (Plate 3, fig. 9). It eats with some deliberation and if disturbed, as by the light of an electric torch, stretches out a muscular neck and looks down upon one. The bat cannot be considered a desirable guest, since its meal is digested and passed in situ, the creature

reversing itself for the latter operation. Evidently a considerable quantity of such food is required to obtain sufficient nourishment. A few of these *Cynopterus* suspended from the roof were captured by means of a long-handled insect net. If gently treated they make docile captives and readily take food from the hand. When offered a wild fig they seize it carefully in their gaping jaws and slowly and gravely eat it. If disturbed, or when in pursuit of one another, they emit a sort of chucking noise. The flight is graceful and practically noiseless, in strong contrast to that of their huge cousins, the flying foxes (*Pteropus*).

A second and smaller species of frugivorous bat, *Carponycteris minima?*, was taken once in the old forestry-station building at Los Baños, and had evidently been attracted there to light. It measured 24.7 centimeters in well-stretched wing expanse. It is classified under the subfamily Carponycterinæ (or Macroglossinæ), the members of which, among other characters, possess elongate muzzle, well-developed canines, low molar teeth, and an exceedingly long tongue which is provided with recurved papillæ near the tip.

The Microchiroptera, or "insectivorous bats," are generally more familiar to us than are the fruit eaters, since they occur abundantly also in temperate regions, and are the bats of the belfry, of human habitations, of caves, etc. They often occur in large numbers in tropical cities in many parts of the world.

What is without doubt a familiar sight to the inhabitant of Manila who is not averse to taking a stroll during the pleasant hour of sunset, when small flocks of Chinese starlings, or "martines," *Æthiopsar cristatellus* (Linnæus), and other birds are speeding home to roost, and the hundreds, aye thousands perhaps, of bats that rise out of the Walled City, or Intramuros district, and make their way, at a height of probably from 20 to 100 meters, over the wide Calle P. Burgos to their feeding grounds. Within the Walled City are massive old Spanish buildings, excellent homes, in their upper portions, for the multitude of bats that inhabit them and the vast winged hosts flying up in flocks indicate that certain buildings or groups of them are more favored than others as roosting places. In about a half hour all are on the wing, and of the two sizes of bats that may now be readily distinguished, the smaller and far more numerous one has generally disappeared in quest of insects, while a larger, low-flying species, and not among the

first to appear, is to be seen flitting over the old moat (now the sunken gardens) that circumscribes the Walled City. At the first peep of dawn the bats seek their roosts. Similar flights of small bats may be observed elsewhere in the Philippines. *Nycticejus kuhli* (*?*), with its unadorned visage and a span of about 30 centimeters across the wings, has taken to living under the corrugated iron roofs of several of the buildings of the College of Agriculture at Los Baños. A visit to the dark and torrid attic of the chemistry building revealed a squeakily quarreling and sleeping population of dozens of bats, ensconced between the convex portion of the corrugations and the supports, or clinging to the large wooden beams, etc.

The Rhinolophidæ are the horseshoe and leaf-nosed bats. *Rhinolophus* (Plate 8, fig. 6), a reddish brown species about 30 centimeters in wing expanse, is not an infrequent visitant to nipa houses of Los Baños, though it probably sleeps elsewhere than in houses. Its face, with the great leaflike folds of skin that surround the nostrils in the form of a horseshoe, is not prepossessing, particularly as it is addicted to twitching the large ears and rapidly working the mouth, as if to make grimaces. It has the habit of hanging down by its feet from the bare tip of some twig or along a telephone wire, and pivoting back and forth there. The same twig may be used as a perch for some nights in succession and probably serves as a sort of dining room for the restless creature. In nipa houses, *Rhinolophus* is occasionally pendant from insulated telephone wires in unlighted rooms or verandas, but more commonly it hooks itself high up under the roof and there pivots and makes facial contortions. Sometimes it pursues night-flying insects into houses, and I recollect a screaming green *Cicada* circling my room, closely followed by this eager bat.

ILLUSTRATIONS

Plate 1

Fig. 1. Nipa house at Los Baños.
2. Looking up at the roof of a nipa house.

Plate 2

Fig. 1. *Amathusia phidippus* Linnæus; chrysalis. × 1.
2. *Eumenes makilingi* sp. nov., female, type; head and pedicel, lateral aspect.
3. *Eumenes makilingi* sp. nov., male, allotype; armature and tip of antenna.
4. *Prionocerus caeruleipennis* Perty. × 5.7.
5. *Prionocerus caeruleipennis* Perty. × 6.17.
6. *Prionocerus caeruleipennis* Perty. × 6.

Plate 3

Fig. 1. Caddis fly; adult at rest. × 0.83.
2. *Odynerus xanthozonatus* Ashmead; young larva suspended in its cell. Enlarged.
3. *Amathusia phidippus* Linnæus awaiting sunset. × 1.
4. *Erionota thrax* Linnæus, the banana leafroller; pupa, showing emergence holes of *Brachymeria* wasps. × 0.55.
5. Firefly larva and its natural prey. × 1.5.
6. *Eumenes makilingi* sp. nov.; mud cells. × 0.62.
7. *Erionota thrax* Linnæus; retreat of large larva, or pupal chamber of the banana leafroller. Much reduced.
8. *Erionota thrax* Linnæus, retreats of young larvæ. × 0.28.
9. *Cynopterus* sp., a fruit-eating bat under a nipa roof, devouring a fig. About × 0.3.
10. *Gekko gecko* (Linnæus), ruler of the ridgepole. About × 0.1.

Plate 4

Hersilia spider on its web on a tree trunk.

Plate 5

Fig. 1. *Microcerotermes los-bañosensis* Oshima, a worker with a parasitic coleopterous larva clinging to it. × 13.1.
2. *Hospitalitermes saraiensis* Oshima, the day-foraging termite; small portion of a column returning nestward in the early morning. About × 2.3.

PLATE 6

FIG. 1. *Odynerus xanthozonatus* Ashmead; *a*, wing of female; *b*, sagitta of male armature somewhat flattened.
2. *Odynerus longitegulae* sp. nov., female, type; wing.
3. *Odynerus xanthozonatus* Ashmead; *a*, tip of antenna, male; *b*, tegula of female; *c*, clypeus of female.
4. *Odynerus longitegulae* sp. nov., type; female tegula.
5. *Rhopalum domesticum* sp. nov., female.
6. *Ancistrocerus domesticus* sp. nov., female; posterior face of propodeum.
7. *Rhopalum domesticum* sp. nov., female; venation.
8. *Crabro makilingi* sp. nov., female, paratype; *a*, clypeus; *b*, palpi.

PLATE 7

FIG. 1. *Myrmeleon celebensis* McLachlan, an ant lion; pits under a nipa house.
2. *Nephila* spider on web.
3. *Polypedates leucomystax* Gravenhorst, banana frog; egg masses.
4. Small house lizard, from Ecuador.
5. Monitor, or *bayawak*.

PLATE 8

FIG. 1. *Gekko*.
2. *Cynopterus*, a frugivorous bat.
3. *Gekko*, eggs and young.
4. *Polypedates leucomystax* Gravenhorst, banana frog.
5. *Heteropoda regia* Fabricius, with egg cocoon. Hawaiian specimen.
6. *Rhinolophus*, an insectivorous bat.

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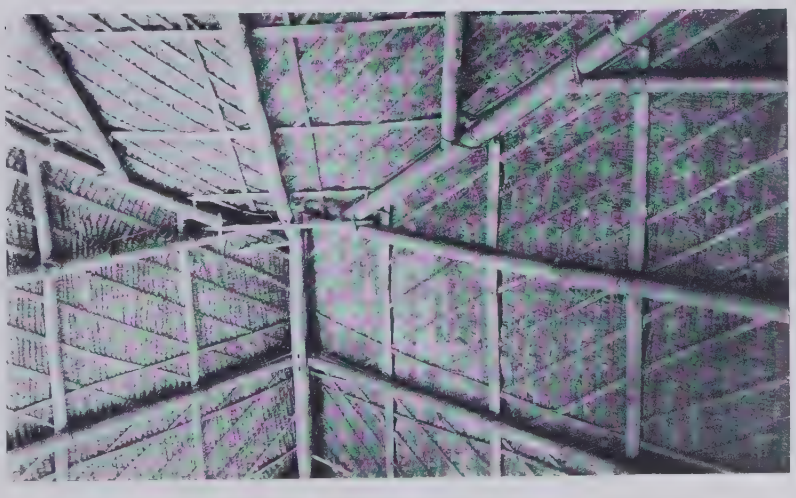

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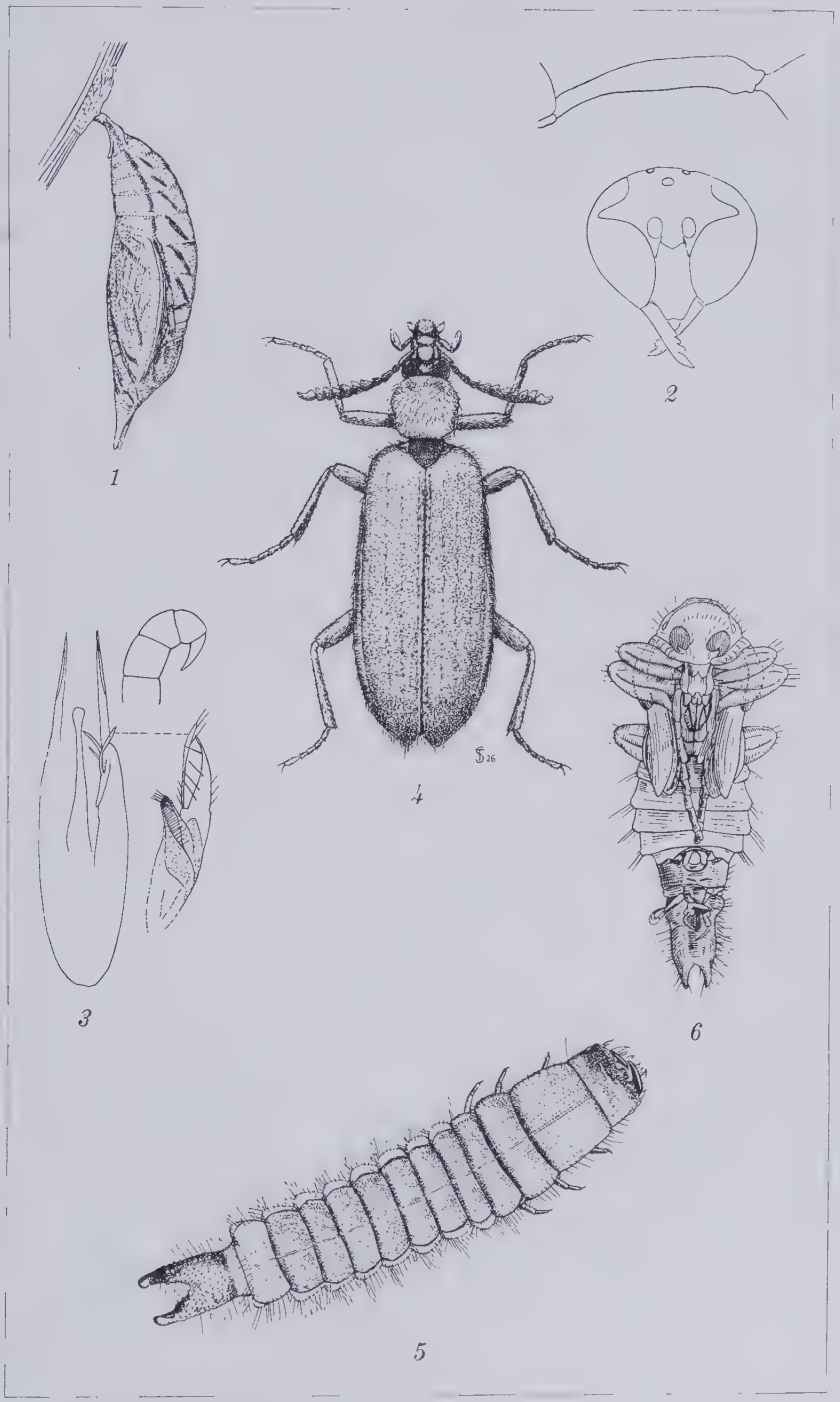

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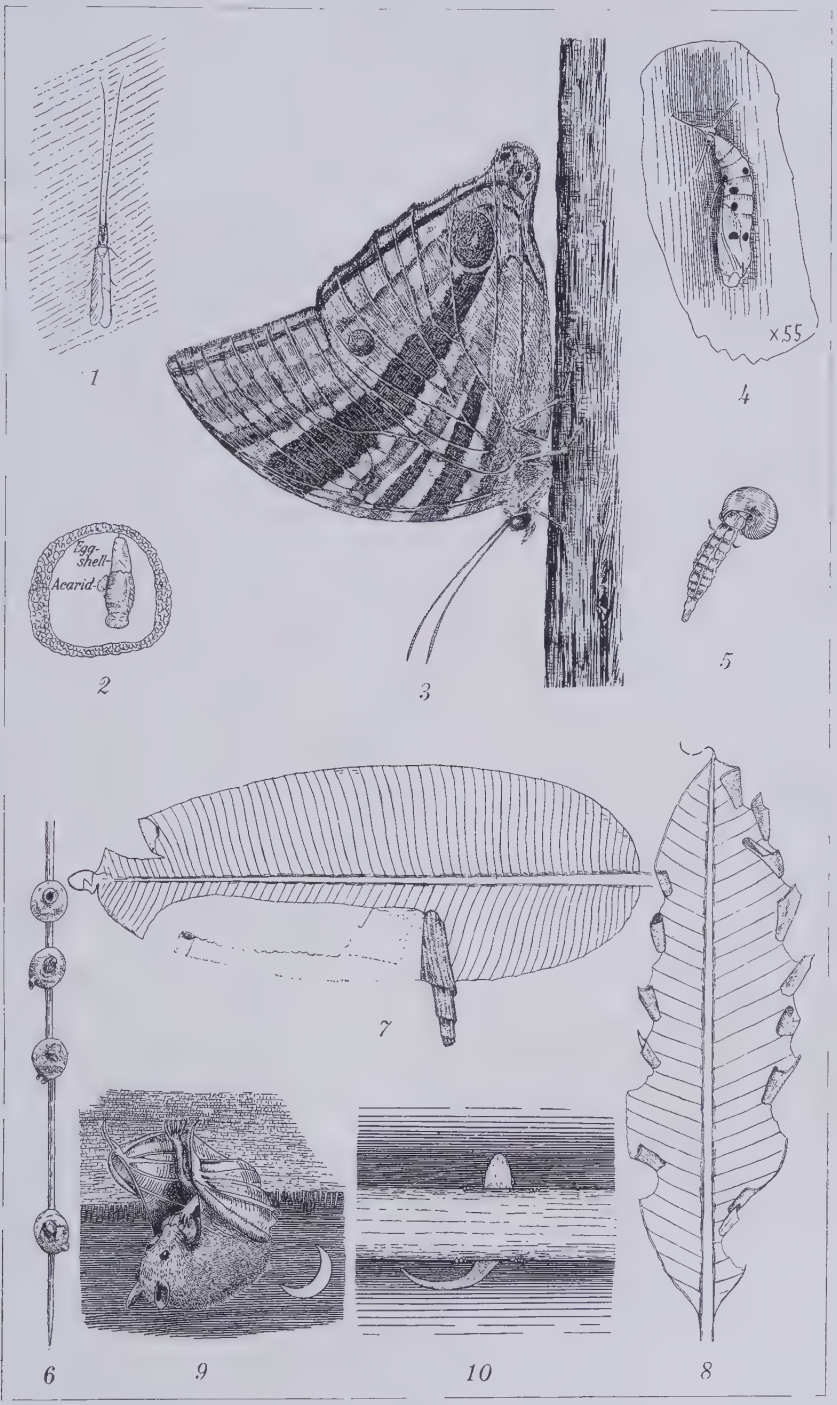

PLATE 3.

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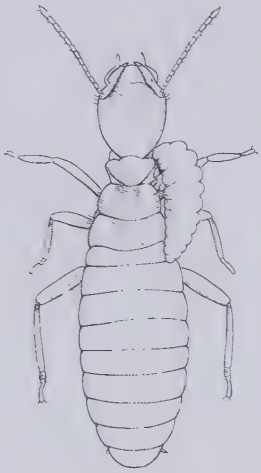

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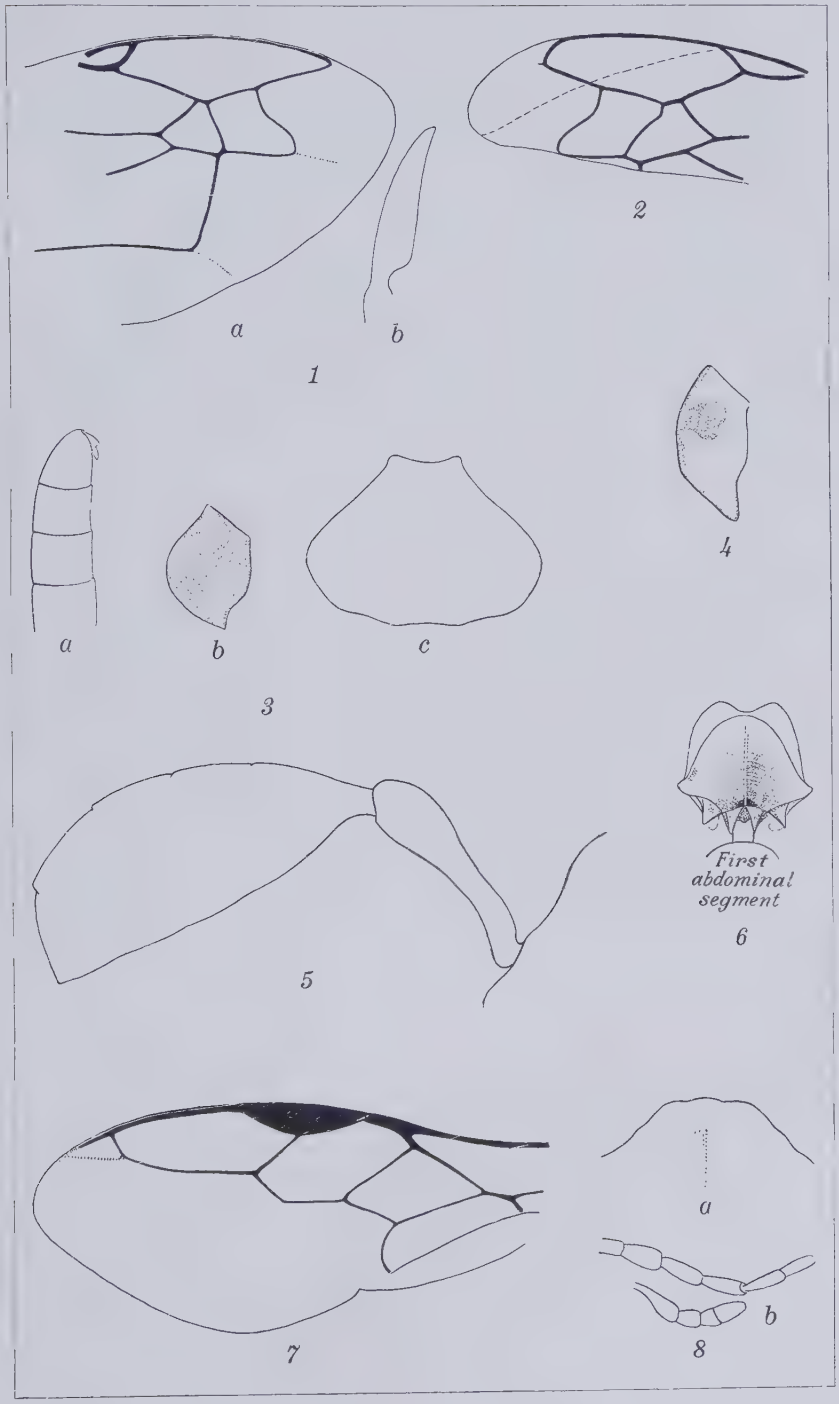

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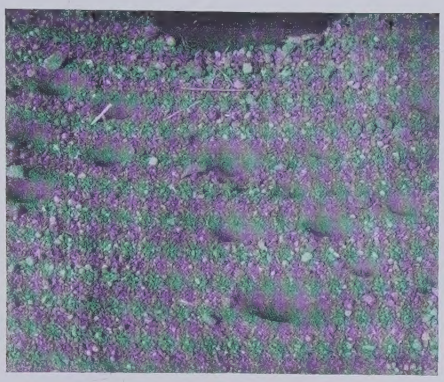

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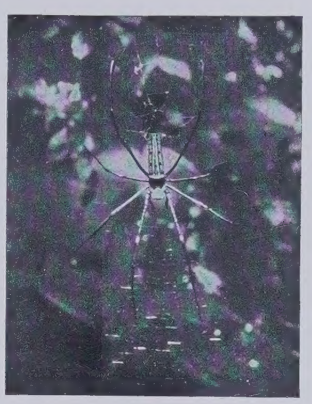

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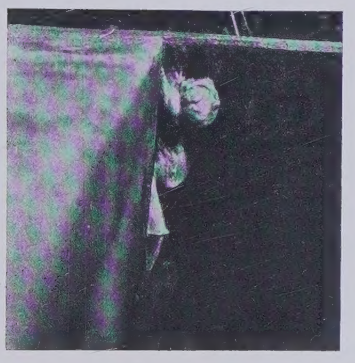

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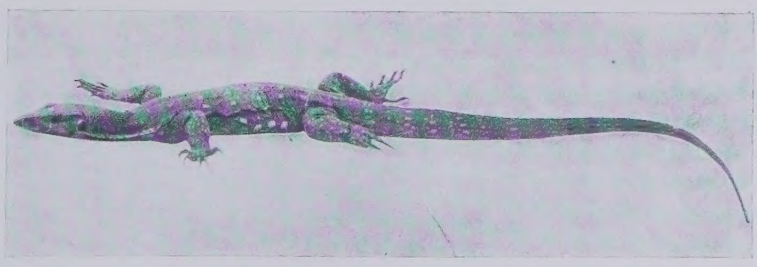

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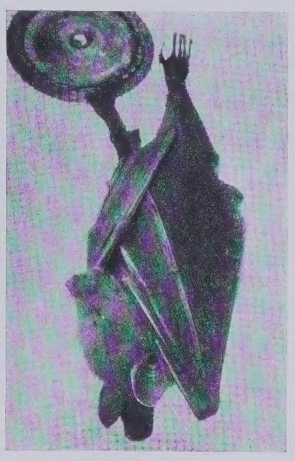

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PLATE 8.